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EDITORIAL

ROADS OF THE FUTURE

An article elsewhere in this number gives some figures to show the magnitude of difficulties met in putting motor trucks into operation on country roads. The argument is only less pertinent in cities because the average city will prepare its streets for the traffic coming to them, whereas the local authorities responsible for the building of country roads are prone to reflect the opinions of their constituents and demand the regulation of the traffic rather than the improvement of the roads.

The figures given demonstrate that the condition of the roads does much to regulate the traffic, but not enough, because whenever a road is good enough for a truck to get over it the truck is likely to be there and to cut the road up so that when bad weather comes it is again impassable to motor trucks or anything else.

The demonstrations of the economy of motor trucks for hauling farm produce to market, particularly the produce of the higher values, are becoming so numerous and so indisputably strong that the farmers and the country road builders are beginning to recognize their value, and their opposition to the improvement of the main traveled roads to carry the heavier weights as well as the larger number of vehicles must soon diminish and ultimately disappear. The farmer himself will profit by the new methods of transportation, and he must soon be driven from his untenable position that the traffic must be regulated to suit the roads, and join in the demand that the roads be built to fit the traffic.

We have called attention frequently to the early waste of money by State Highway Departments caused by lack of consideration of the probable increase in weight as well as volume of traffic, resulting in the construction of roads which were too light for the traffic which developed immediately upon the completion of the roads. Many of these roads have been reconstructed, others resurfaced and others are still sources of excessive maintenance expense in order to keep them in passable condition for this new heavy traffic.

The newer State Highway Departments should profit by these earlier lessons and not fall into the same errors.

We have been demonstrating the proposition as thoroly as possible from a theoretical consideration of the combination of facts available. The figures referred to above add practical points to the other arguments and point the way to the source of still other information which will give still further aid.

The vicious circle will soon be broken, and it will be impossible except in the most remote districts to argue against the fullest improvement of the roads because the traffic is not there to demand it, whereas the traffic is not there for the sole reason that the road is not good enough to carry it.

GLORIFICATION OF CONCRETE

The cement show and the attendant conventions in Chicago in February have put the annual emphasis on the uses of concrete which has ranged from the simplest and most empirical machine for performing some little operation, exhibited in the Coliseum, to the most abstruse theoretical discussion of the composition of cement and its action in setting at the American Concrete Institute.

While such a concentration upon one subject may sometimes carry one forward too fast, there is no question that such concentration results in a more rapid advance in both theory and practice of the use of the product and is of the utmost benefit to the user of cement, as well as to those interested in supplying the materials and machinery required for concrete construction. The rapidity of this advance can be judged only by going to the meetings and the exhibitions and comparing the presentations with those of former years. One not continually in touch with the development cannot express his astonishment at the rapid strides made each year.

AGGREGATES FOR CONCRETE

The most important subject at the present time in the engineering world is that of aggregates for concrete. It was the center of attention at the recent meetings of the American Concrete Institute and the Conference on Concrete Road Building, and occupied a very large share of both programs. The fact is that the development of the use of concrete roads has been faster than the development of experts to supervise their construction, and when it comes to making specifications for materials which will be definite enough to turn over to less experienced superintendents of construction the experts find that they do not know enough about either broken stone or gravel to be able to make fool-proof specifications. Hence the anxiety and the pressure from all sides upon the expert investigators. Some of their work is outlined in this number and other endeavors will be described as they show promise of good results.

WATER SUPPLY PROBLEMS

ALONG THE OHIO RIVER

By Webster Frank, M. C.

The small cities along the Ohio river formerly had no particular problems regarding their water supplies, for any practicable intake would give them all the water they wanted for all purposes, sedimentation being desirable for a part of the year, tho by no means indispensable. As population, manufacturing and mining have increased the pollution of the river has increased, and the problems of these small cities have multiplied. This article tells how some of them have been solved in a practical fashion, and the descriptions of failures and successes give indications of how not to do it as well as how to get good results.

FORTY years ago the Ohio river, from Pittsburgh to Wheeling, bore close inspection as a thing of beauty. Its color was pleasing, the people drank the water, and sometimes bathed in it. Fish grew to a healthy old age in its waters, and many a man made his pin money from the sales of his night catches on anchored lines set out each evening.

Today the scene is vastly different. The waters are green and murky with sewage. Whole schools of fish, yes, acres of them, have floated belly-up to their happy fishing grounds, and the stench from their decaying flesh has been loud enough to attract the buzzards. Any one who drinks the water nowadays does so at the great risk of burning out his internal plumbing system.

The change from purity to impurity of the water has been brought about by the increase of the population, and from the scores of manufacturing plants that now adorn both of the banks of the river.

Numerous private and municipal sewage systems have been built to drain the pollutions from humanity and from manufacturing processes into the stream. From the manufacturing plants is now emptied a flood of acidulated fluids from various cleaning baths, and of poisonous liquids from electroplating and decorating solutions. The raw water is now used only as a transportation system to float coal boats, and for carrying away refuse.

The changed conditions in the Ohio river have brought up some serious water supply problems for the people to solve. Naturally, the people have been slow to give way to new and more costly methods. The springs and wells had to be discarded. These wells have been both private and public. The latter were located on the street corners, and they were kept in good condition or repair by the town constable.

Before the advent of the city water works, the wash-day trade was supplied by enterprising draymen with their casks mounted on two-wheeled carts. They would drive into the river up to axle depth, and load up by using a bucket nailed to a stout bar for a ladle. Then the delivery into the house barrels was made thru a hose from the bottom of the cask. The charge was 25 cents per load of three barrels.

The Wellsburg Municipal Plant.

The development of a typical water plant along the Ohio river as used by a town having a population of about 5,000 people, is well illustrated by the one at Wellsburg, W. Va. This plant was started in a very modest way. Really, the first running water for commercial use was furnished by a private individual, Mr. Tucker by name, who erected a wooden tank on his yard and piped his own house for both bath and kitchen service. He also had the first hose sprinkling service in town. A small boiler and pump at the river's edge did the pumping. Several nearby residents availed themselves of the privilege of purchasing the water.

Following the educational leaven of the private plant came the one built by the city to furnish water to every citizen and to insure purer water. At first a crib intake suction pipe was laid in the gravel of the river bed and water that was partly used. But this construction was of short duration, owing to its lack of stability and the poor water.

At present the supply comes from eight wells sunk in the river bed. These consist of 60-inch cast-iron sections sunk into the underlying sand and gravel and closed on top, excepting that an 8-inch suction pipe leads from each well to the 16-inch suction line to the pump.

After a while these eight wells did not furnish enough water for the service, and a large well was sunk near the water's edge on shore. This well is 15 feet in diameter and 35 feet deep. The wall is 19 inches of brick with a reinforced concrete cover. At first this well was not a success, as it was not deep enough to shut out the up-flow of sand and gravel from the bottom. This has been remedied by driving sheet piling inside the well casing to hard pan, and cleaning out the contents to the bottom. Then numerous lengths of cast-iron pipe were driven radially from the casing into the water bearing gravel surrounding the well. This plan has given the quantity of water needed at present, but the water is harder than that from the river wells.

THE PUMPING PLANT.

The pumping machinery is housed in a substantial two-story building of brick and concrete, as shown in the illustration. The second-floor elevation is necessary in order to protect the equipment from the frequent high water inundations to which the Ohio river subjects the valley.

The wall of a dry well about 25 feet in diameter extends from 3 feet or so above the station floor, and the well is deep enough to locate the pumps within suction distance of the water; that is, the intention has been so to do, but it is said that the suction is as great as from 17 to 25 feet.

The first pump installed was a Knowles compound duplex with 12½ and 18-inch steam cylinders and a 10½x12-inch pump plunger.

Later there has been added a twin vertical compound Epping-Carpenter engine, located on the station floor, and having steam cylinders 16 and 25 inches, operating a pump that is 12½x24 inches and having a capacity of 2,000,000 gallons.

The boiler plant has one 150-h.p. Erie return tubular boiler, and one 200-h.p. Casey-Hedge boiler with two Morrison furnaces. The former has sixty-eight 4-inch tubes and is fired with gas. The latter has eighty-four 4-inch tubes and two 3-foot Morrison coal burning furnaces. The shell is 13/16 inch, quadruple riveted, and carries a working pressure of 160 pounds.

The reason that both fuels are used is that an old contract

between the city and the gas company allows 400,000 cubic feet of natural gas per month for a flat rate of $25. As the price of natural gas has been greatly increased since then, any additional fuel needed is furnished by bituminous coal at $1.45 per ton for run-of-mine coal. The gas supply lasts but about six days per month now.

The new Casey-Hedge boiler, while of efficient design, is not yet lagged, owing to the fact that no appropriation has been made to cover the cost of $150 needed for the work.

THE RESERVOIR.

From the pumping station to the reservoir, over one mile distant, two 10-inch lines of pipe are laid. The plan of using two pipes gives excellent satisfaction when cleaning the reservoir, making repairs, and the like. The first reservoir was a small affair built on the side of the hill. But the new one, which was constructed in 1903, is located on a level field on top of the hill. The elevation gives a static pressure of 141 pounds at the pumping station.

The new reservoir is square, 225 feet on a side, with curved corners. It is deep enough to hold 16 feet of water. The gravel-concrete wall is about 12 inches thick with a coping of 2 feet or so. The top of the wall is vertical for about 4 feet and the lower part slopes at 45 degrees into the floor of the bottom.

Besides the two 10-inch inlets, there is a 16-inch cleaning outlet led into a ravine in the rear of the reservoir. This cleaning pipe has a door valve. The reservoir is cleaned once per year. The sides are scrubbed down and the whole bottom washed free of filth. There is no screen or fence around the wall to prevent leaves and small animals from accumulating in the water. To clean the reservoir requires five men for two days.

When first built this reservoir leaked badly. Quite a number of cracks developed in the walls. Aside from the general patching required, the leaking was not stopped until the surface of the gravel-concrete was coated with two coats of linseed oil.

WATER RATES.

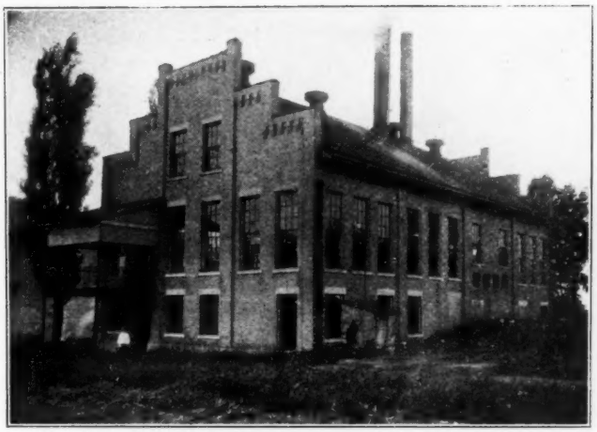
Flat rates have prevailed, but meters are being put in gradually. The new state law requires the installation of meters when demanded by the user.

The water user is most interested in these two things: Quality and cost. The quality of the water from the Wellsburg plant has never been ideal, as it is not always clear, it has some hardness, and the purity is not above question. The scheme of wells as actually operated does not furnish real filtered water, so that the quality is liable to vary from excellent to dangerous.

As to cost, the water plant owned by the municipality is a great success. The rates are surely low and the quantity enough for all purposes. In the first place the city has sixty-eight high pressure fire plugs and all the water needed for sprinkling absolutely free. Water is also furnished free to the city-owned buildings.

About 5,000 people use the water, and all the manufacturing plants are large users, because, for some reason or other, their private plants do not supply their needs. The family service, of course, is the standby for revenue to cover cost of operation. The flat rates will be understood from an inspection of the accompanying quarterly bill.

It will be noted that the first item is a charge based on the rental value of the house. The rate is ⅜ per cent. of this value. Thus, if the laborer's house would rent for $6 per month, or if he pays this rent for it, then the item of fixed charge per quarter is ⅜ per cent. of $72, or 27 cents. The charge is also 12½ cents per quarter for each individual in the family, and this is duplicated for the privilege of a bath. The charge for a toilet is $1.25 for a quarter, and fixed charges



THE PUMPING STATION *of the municipal water works plant at Wellsburg, W. Va., taking water from the Ohio River.*

are made for autos, lawn hose, motor washers, etc. The meters are read monthly, but the bills are rendered quarterly.

The typical bill, as shown, is that paid by a well-to-do family of man and wife for the quarter ending July 1, 1915. As the new law requires meters when demanded, a few have been installed in Wellsburg already. A comparison of the bills paid "before and after" shows clearly either that the water service is very reasonable and of low cost, or that the meter rates are too low.

Man, wife and child, no closet in the house, meter cost, 60 to 90 cents per quarter.

Family of five, flat rate, $5.00; meter rate, $1.30.

Family of a physician, including auto, 60 cents.

Barber shop, $3.30.

Large livery stable, $7.50.

Restaurant, $6.30.

Three-story store building, one store and three families, $2.10.

COST AND VALUE OF THE PLANT.

The entire plant represents an outlay of about $65,000, with a bonded indebtedness on hand of about $25,000 or $30,000 yet to pay off. A spot cash price of $125,000 has been offered for the plant by parties proposing a stock company to operate it. The offer was promptly refused by the city fathers.

The Follansbee Stock Company Water Plant.

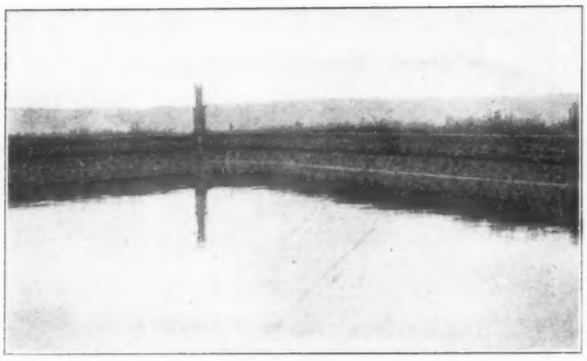
One of the latest water plants is that in the new town of remarkable development, Follansbee, W. Va. This water plant is owned by a stock company and has been a great success from the beginning.

The plant seems to have been of the right kind, put in at the right time and in the right way. No changes or additions have been made.

The water for this plant is secured from drilled wells sunk at a considerable distance inland from the river. There are three of these wells, which are 10 inches in diameter, and located 8 feet apart. They are over 100 feet deep and tap an excellent water bearing gravel which supplies a water that has a good taste and which is practically pure at all seasons. It has a slight hardness, however, that prevents its being perfect for washing purposes.

The casings for these wells comes up thru the bottom of a concrete sump, which is probably 25 feet long, 8 feet wide and 5 feet deep. Each well is equipped with a Harris air lift, using compressed air at 40 pounds per square inch.

The water station is a well-appearing single-story brick



A CORNER OF THE RESERVOIR *of the municipal water system at Wellsburg, W. Va., into which Ohio river water is pumped for settlement and distribution. the reservoir requires cleaning only once a year.*

structure with a heavy concrete foundation and floor. It is a gas-operated plant, having one 80-h.p. Riverside gas engine, using natural gas from nearby wells. This engine is connected by a clutch to a heavy jack shaft which it drives by a belt. Clutch pulleys on the jack shaft operate a 10x10 vertical Deming high-pressure triple-plunger pump. This forces the water from the sump to the reservoir, which gives a static pressure of 157 pounds. A second clutch pulley operates a 14½x10 single-cylinder Ingersoll-Rand air compressor, which furnishes the air at 40 pounds to lift the water from the wells.

A Jacobson gas engine of 4½ h.p. is used to operate the starter for the large gas engine. A single 8-inch line is laid to the reservoir. The reservoir is brick lined, the bricks being laid on a blue clay bed, and has never leaked.

About 125,000 gallons are required for the service each day. The station must be operated on an average of five hours per day to keep up the supply. Each of the several manufacturing plants has its own plant and does not use the city water, but they have high pressure water plugs. The city has seventeen of these plugs, and pays $50 per year each for them. All the service lines have meters, and the rates are as follows:

Minimum rate per quarter, $1.50.

Fifty cents per thousand for 6,000 gallons or under; 45 cents for 7,500 gallons, and down to 15 cents for 1,000,000 gallons.

So far the only trouble with the plant operation has been the cracking of the pump base, and the first type of meters had to be changed for more reliable ones.

FLAT RATE QUARTERLY WATER BILL FOR A SMALL FAMILY SERVED BY A CITY-OWNED PLANT AT WELLSBURG, W. VA.

No. 22 **Wellsburg, W. Va.** July 1st **191** 5

O. S. Johnson

To WELLSBURG WATER WORKS, Dr.

Assessment from April **1st, to** July **1st, 191** 5

RECEIVED PAYMENT July 10 **191** 5

John Doe **City Col. and Treas.**

Rental Value $ 1.96 at 3-8 per cent		73
Persons 2 @ 12½c.		25
Bath Room " " "		25
Water Closet 1	1	25
Store		
Horses		
Carriages		
Cows		
Lawn or Garden		
Street Hose		
Boilers		
Washer		
Specials		
Total $	2	48

SPECIAL RULES

No. 1. The use of water for any other purposes than that named in this bill is absolutely prohibited.

No. 2. Non-paying consumers are to be strictly forbidden the use of water from the hydrants of others who have paid, under penalty of having water shut off from the latter without further notice.

No. 3. All persons not paid on or before the 10th of the month will be shut off according to Rule 13, without further notice.

No. 4. Collections are made the first day of January, April, July and October.

No. 5. No hose will be charged for less than a season. Hose limited to 20 feet; 5 cents extra for each extra foot.

MONOLITHIC BRICK PAVEMENTS

**By Maurice B. Greenough, Instructor in Highway Engineering,
Case School of Applied Science, Cleveland, Ohio.**

The monolithic construction of brick pavements has attracted so much favorable attention that this full comparison of that method of construction with those which have preceded it, and its definite classification, will be very acceptable. It is from a paper before the Ohio Engineering Society.

AT the present time, the monolithic type of construction is of two kinds, both representing a breaking away from the practice of constructing brick pavements in two parts, separated by a layer of foreign material, but one more gradual than the other. In one we have no radical change in the relationship of the various elements of the structure. It differs from the sand cushion type only in the addition of cement to the cushion course, producing a part which might more properly be called a cement mortar bedding course. A union is made with the finished surface of the concrete base, but it is only such union as may be obtained by bonding a thin layer of cement mortar to a prepared concrete surface, and to the bottoms of vitrified paving brick. Such is the method of construction applied in Baltimore, St. Louis, Cuyahoga county, and to a slight extent in Cleveland, during the past two years.

The other, as typified by the newly-built roads at Paris, Ill., is a complete divorce from the old order. It represents the final step in consolidating the wearing surface and the foundation, so that both contribute their united strength to the structure. All semblance of a cushion or special bedding course is done away with, and the vitrified wearing surface is completely bonded to the green concrete base.

In that type in which the bricks are laid directly on the green concrete foundation, developed originally for country roads, but since applied to city streets, the preparation of the sub-grade differs in no respect from that of any improved road. Thoro drainage must be insured and a uniformly compacted sub-grade created as the foundation.

Steel side forms are placed in position as far apart transversely as the width of the finished roadway. They are held firmly in position, true to line and grade, by steel pins driven into the sub-grade about 10 feet apart.

A concrete mixer, supported by planking to prevent injury to the prepared sub-grade is placed in the center of the roadway, with the coarse and fine aggregate in the proper amounts deposited in piles ahead of the mixer. Whenever possible the aggregate should be placed outside the limits of the prepared sub-grade in order to prevent the risk of injury by trucking. When it is impossible to avoid dumping the aggregate on the prepared sub-grade, a layer of sheeting should be spread upon it for vehicles to maneuver upon. The cement in sacks is placed in a position convenient to the mixer.

For convenience and simplicity in operation, the mixer is equipped with a conveyor bucket traveling on a boom about 20 feet long, in order that the concrete may be deposited quickly without disturbing the sub-grade.

When the work begins, concrete of a quaking consistency is deposited from the conveyor on the sub-grade between the forms. It is then roughly struck off by means of shovels to a depth about 2 inches greater than the required depth of foundation. The concrete having been deposited, roughly struck off, and spaded along the side forms in order to allow only mortar to come in contact with them, the foundation is struck off to a true surface and luted by means of a double template, in which has been placed a dry premixture of sand and cement in the proportions of one to four. The template is attached to the mixer by a chain, fastened to each end of the template, forming a triangular hitch, from the center of which another chain passes to the mixer.

The forward motion of the template may be obtained either by driving the mixer ahead on the planking or by winding the chain on a specially prepared drum on the mixer. Of the two methods, the latter is preferable, because of the greater smoothness of pull and the lessened danger of disturbing the sub-grade.

NO CURB *laid on the Middle Springfield road, Paris, Ill., monolithic brick pavement construction.*

The character of the double template is of the utmost importance and may well be called the salient feature of this method of construction. As developed at Paris, Ill., and very successfully used there, it consists of a forward cutting edge, an I-beam, and a rear cutting edge, a channel with the flanges placed outward. The I-beam and the channel are spaced from 2 to 3 feet apart. The bottom of the rear cutter is about 3/16 of an inch higher than the lower edge of the forward cutter. With the space between the two filled with dry sand and cement, a forward motion of the template first cuts off the concrete and then fills all irregularities in the surface with the luting mixture.

Sufficient water is used in mixing the concrete so that enough will work to the surface and be absorbed by the luting mixture to insure its thoro hardening.

The surface thus created in the rear of the template is remarkably smooth, entirely free from depressions, and is ready to receive at once the brick surface. No difficulty has been experienced in laying the brick in the usual manner, having them brought

in on pallets with the best edge upward, the dropper standing upon the brick just laid. There is sufficient rigidity in the green concrete base even at this stage to resist the formation of any depressions in the surface by workmen moving about upon it. It is well, however, to have boards laid for the men to walk upon.

The brick setting is immediately followed by rolling. A light hand roller weighing from 400 to 500 pounds has been found entirely adequate to obtain a remarkably smooth surface; in fact, the surface obtained before rolling is as smooth as many sand-cushioned streets after rolling.

In agreement with the general plan of operation in the Paris construction, grouting is made a specialized operation. All new work on the road stops about an hour before closing time for the day and the whole force of men excepting those who will be noted are detailed for grouting. A few workmen remove the forms from the previous day's work and place them in position for the coming day's operations. One or two men may also be detailed for cleaning up and making such minor repairs on equipment as may be necessary, so that work may proceed uninterrupted on the following morning.

The grouted surface is allowed to stand uncovered until the following day, when it is covered with a protective layer of sand or earth, moistened to prevent too rapid drying of the concrete.

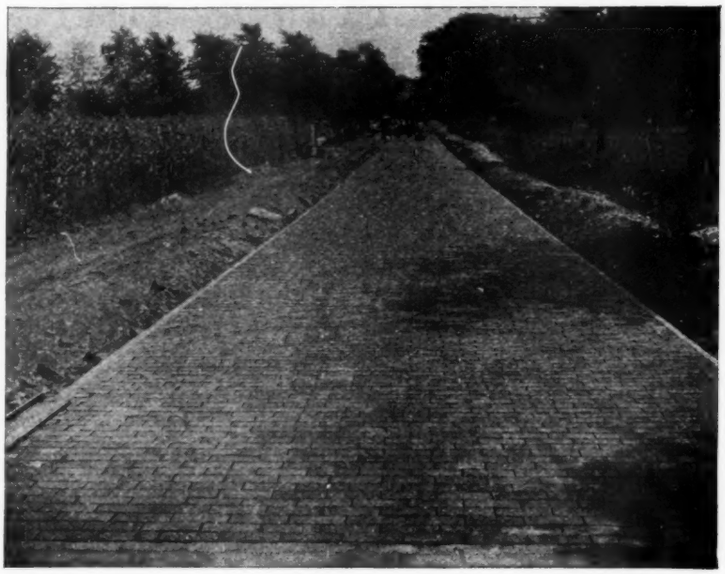
Between 400 and 500 linear feet of 10-foot roadway was the usual day's progress at Paris.

That type of monolithic construction employing the sand-cement-mortar bed thus far has been constructed by the same methods as the sand cushion type, with the exception of premixing the sand and cement in the proportions of one part of cement to three or four of sand. The cushion thus prepared is struck off by means of a template, rolled with a hand roller weighing between 300 and 400 pounds before the bricks are placed in position. The bricks are sprinkled before grouting so that moisture is added to allow the mortar bed to harden thoroly.

If we compare the two methods of building monolithic brick pavements on the basis of results already demonstrated, we find that the sand-cement-mortar type has increased the cost of construction, while that method by which the brick are placed on the green concrete base has decreased the cost of construction.

In the sand-cement-mortar bed type, the base is prepared in advance and allowed to harden exactly as if the sand cushion type were to be built. The same depth of brick is used and the same concrete edging or curb has been retained that were formerly employed. The increase in cost arises thru the introduction of the cement in the cushion material. Any saving in the amount of sand used and in allowing faster dropping of the brick is offset by the cost of the cement and the cost of premixing the cement and sand. The net result is an increased cost per square yard for the construction. In the Paris type of monolithic construction a saving is effected by the saving in materials and specialization of the various functions of construction.

Thus far, the majority of the pavements of the Paris type have been constructed on country roads whose width is between 10 and 15 feet. It has, however, been successfully employed at St. Louis at the intersection of two streets 36 feet in width. A street has also been paved in this manner within the limits of Paris, Ill. Two operations were made of striking off and luting the concrete foundation in this instance. The theory that such construction could not be adapted to city streets because of their greater width seems to be disproved



ONE DAY'S WORK *on the Middle Springfield road, Paris, Ill.*

by these demonstrations. That portion of the pavement at street intersections which could not be built by the forward motion of the template was struck off and luted by hand with good success. As an alternative method of constructing such places, it is possible to leave forms in place and to return later and strike the surface off at the proper elevations.

The sand-cement-mortar bed type has had its widest appreciation in city practice, with the exception of some 45,000 square yards laid in Cuyahoga county, Ohio, during the season of 1915. In this work the depth of the base was made the same as that for the sand cushion type and the concrete edging was retained. One of the advantages of the Paris type is found in the elimination of the curbing or edging for country roads, so that from the point of view of effecting economy in materials this type has the advantage over the sand-cement-mortar bed type.

In analyzing the monolithic construction of brick pavements from the point of view of the three interests involved, the speaker used the Paris type with the brick on the green concrete as the basis, in the belief that this is the ultimate aim of all monolithic construction.

From the Point of View of the Contractor.

Executives are agreed that the maximum efficiency in operation and organization obtain when the same men continue to exercise the same functions, in other words, specialization of effort. Effective effort on the part of workmen building a road is obtained when each man becomes thoroly familiar with the work which he has to perform and particularly if he has but one kind of work to do. In road construction the tendency to create dullness by specialized effort is offset by reasonable hours of labor, out-of-door environment, competition between other men performing other functions and proper supervision and oversight on the part of foremen and the contractors themselves. Because of the simplicity of the operations involved newcomers fit easily into the system.

Again, economy in materials, which decreases the amount of money which must be tied up during the prosecution of a contract, appeals, strongly to the contractor. A type of construction which promises to be a credit to the man performing the work and one in which the hazards of unknown and unfore-

seen circumstances are reduced to a minimum commends itself strongly to the contractor.

All of these conditions are satisfied by the Paris type of monolithic construction. The entire force engaged in building the pavement is distributed over a distance of less than 75 feet along the road, encouraging economy by making possible strict supervision of all the work. The same men perform the same operations continually. For instance, certain men are always engaged in roughly striking off the concrete base and spading it about the forms; others are mixing the sand and cement luting course and keeping the template well filled; still others are constantly bringing in brick for the droppers, and so on. Thus, the entire operation proceeds at a uniform rate of speed thruout the day. There is no confusion or loss of time by changing duties. Economy in materials is effected by the elimination of the curbing or edging in country road construction. A saving is made in the amount of sand and cement required for the luting course over what would be required for a sand-cement-mortar bedding course, or even a plain sand cushion.

No time is lost in waiting for a concrete base to harden before brick laying may commence. In other words, there is no call for equipment to be brought on to the work until actual operations of constructing the pavement begin. Of course, the sub-grade must be prepared, but except in unusual circumstances that may be going on simultaneously with the construction of the pavement only far enough ahead so that no time will be lost by breakdowns or other unforeseen delays in preparing the sub-grade.

In the use of the special template which both strikes off and lutes the concrete foundation is found the critical point in construction. No make-shift template should be employed. It should be substantial and designed particularly for the work to be performed by it. The cost of the template is very small in proportion to the economy effected by its use. For the contractor who expects to build monolithic brick pavements, the cost of attaching a winding drum to the mixer for drawing the template ahead, is also relatively small and is entirely justified by the results secured.

BRICKS REMOVED *from the pavement on the Middle Springfield road, Paris, Ill.*

From the View Point of the Engineer.

The principal defects of the sand cushion type of brick pavements have been longitudinal cracks and surface depressions, caused by soft spots or shifting in the sand cushion, by imperfect grouting or combinations of the two effects. The presence of moisture in the sand cushion which may freeze and expand during cold spells may also be a contributing factor in the formation of longitudinal cracks. One thing is certain, that the elimination of the sand cushion eliminates its hazards as well, and defects that develop must be attributed to some other course. So far, no longitudinal cracks have developed in monolithic pavements.

The opinion of engineers has been expressed from time to time that they feared that at the end of five or six years, the bricks would become broken and battered on account of the anvil effect of the base when the surface is subjected to moving loads. In the absence of any specific data to prove or disprove this opinion, recourse must be made to a pavement constructed in Terre Haute, Ind., by this method, now twelve years old.

The pavement mentioned was laid at the side of Hulman and Company's building, leading from the thorofare into the railroad yards. Thruout its life it has been subjected to heavy trucking. Originally it was provided with a stone curb at the side which for a time received the shock of loads coming diagonally upon the side of the pavement, since the entrance to the yards must be made by turning off the side and not directly off the end of the pavement.

A recent examination of the pavement by the speaker showed that the curb has been entirely disintegrated where vehicles come on to the pavement, and that excepting a slight cobbling of the exposed edge of the brick, the surface near the edge has received no injury. The entire surface of the pavement showed no defects. Such wear has occurred as might be normally attributed to heavily concentrated traffic. It may also be said that the bricks never received any rolling when they were laid.

We know that the ability of any structure to withstand the shock of suddenly applied loads depends upon the ability of the material to yield slightly and to store within itself internal energy equal to the amount of the external energy applied to produce the given state of distortion. This storage of internal energy is evidenced by the elastic recovery of the structure to its original position upon removal of the load. We commonly describe this function of a pavement as its resiliency. Just what the resiliency of a 4-inch brick surface firmly united to a 4-inch concrete base will be, is something to be determined by actual measurement.

A few measurements have been made to determine the resiliency of brick pavements by Mr. James E. Howard, of the Interstate Commerce Commission, but beyond indicating a feasible line of investigation, his results are not yet available for accurate computations. He measured resiliencies of brick pavements under a load of one-fourth a total vehicular weight of 5,540 pounds, and found them to range between three ten-thousandths and one one-hundredth of an inch, but unfortunately his report does not describe the type of construction.

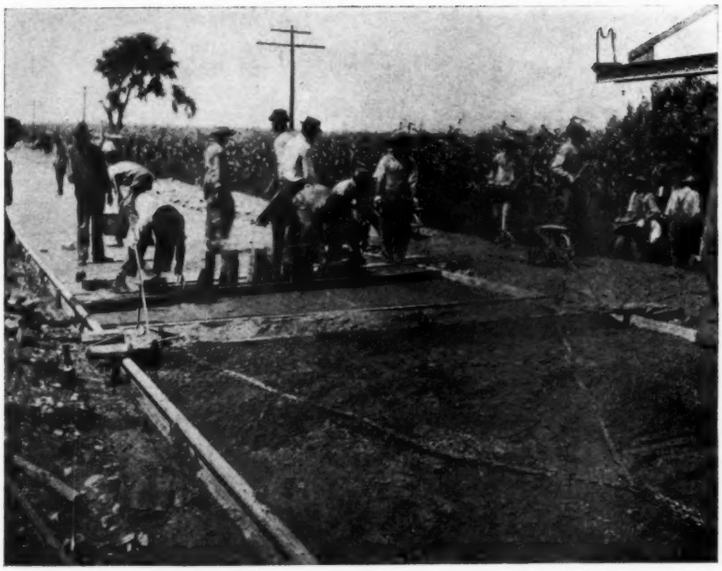
There is evidence to lead one to conclude that in some instances the elastic limit of the surfacing has been exceeded in the stresses created by deflections, and, of course, under this condition no elastic recovery could take place and permanent deformation resulted.

A careful study of monolithic pavements leads to the conclusion that they are inherently stronger and better suited to withstand successive deflections without injury than is that type having the wearing surface and the foundation acting separately, the only

connection between the two being dependent upon a layer of sand which may or may not establish a contact.

A careful conception of monolithic brick pavements is reached when they are considered in the light of a brick wearing plate, well adapted to resist attrition by traffic, combined with and supported by a layer of cheaper materials, possessing qualities which adapt it admirably as a foundation.

The taxpayer's interest in improved roads lies not only in having a smooth and comfortable road over which to ride, but also in how much he must pay to secure such a road. His interest in monolithic construction is quickened by the knowledge that a type of construction for brick roads has been developed which promises to be equally and probably more satisfactory than the sand cushion type, and, as has been indicated by work thus far performed, it is secured at a cheaper price. Actual performance under many different conditions is the ultimate criterion for judging the merit of any type of construction, but in the light of what is known of pavements and other structures of similar character, an opinion that an improvement has been made that will produce a pavement of superior quality to those built with a sand cushion seems at the present time to be justifiable.



LAYING THE BRICK *on the Middle Springfield road, Paris, Ill., monolithic brick pavement construction.*

Materials Required for Road Construction

Convenient Tables for Foremen of Storage Yard and Road Work as well as for the Estimating Engineer and Contractor.

TABLE GIVEN TO STORAGE YARD FOREMAN—AMOUNTS FOR 1 MILE OF ROAD

	Pebbles			Sand			Cement		
Width of Road	Cu. Yd.	Tons	Carloads	Cu. Yd.	Tons	Carloads	Bbl.	Tons	Carloads
12 ft.	1369	1916	55	684	855	20	2396	455	13
15 ft.	1711	2395	69	855	1069	24	2995	569	16
16 ft.	1825	2555	73	912	1140	26	3194	607	17
18 ft.	2053	2874	82	1026	1383	31	3594	682	20

1 cu. yd. pebbles, 1.4 tons; 1 carload pebbles, 35 tons; 1 cu. yd. sand, 1.25 tons; 1 carload sand, 44 tons; 1 cu. yd. cement, 0.19 tons; 1 carload cement, 36 tons.

TABLE GIVEN TO MAN ON THE GRADE—AMOUNTS TO BE PLACED PER 100 FT. STATION.

Width of Road	Bbl. Cement	Yards Gravel	Yards Sand	Wagon Loads Cement	Wagon Loads Gravel	Wagon Loads Sand
12 ft.	45	26	13	4	20	10
15 ft.	56	33	16	5	25	12
16 ft.	60	36	17	6	27	13
18 ft.	68	39	20	6	29	15

Cement—45 sacks to 1 load; gravel—1 1/3 yd. to 1 load; sand—1 1/3 yd. to 1 load.

ELECTRIC POWER IN SEWER CONSTRUCTION

By Bayard W. Mendenhall, Salt Lake City, Utah.

Where electric current can be obtained at reasonable rates, and where the electric power lines parallel the work, whether of sewer or pavement building, within a reasonable distance, the flexibility of this method of power transmission is certainly to the advantage of the contractor. This article shows what has been developed in this line in a practical way on sewer work, and certainly the method is attractive in description. The fact that the current is used in the daytime should make a low rate possible, especially when the electric plant has a large lighting load and needs power load during the day to produce the highest plant efficiency.

THE Salt Lake Division of the Utah Power & Light Co. has been making rapid strides during the past two or three years in the introduction of electricity for use by contractors. The thing which has done most to make its use possible in many jobs is the introduction of the use of portable substations, one of which is shown in one photograph. One of the first contractors using electric power extensively was the Ulen Contracting Company of Chicago, on a contract in Salt Lake City, having approximately seventy miles of trenches and sewer pipe varying in size from six inches to six feet.

Practically the entire district had much water in the subsoil, the permanent water table varying from two to ten feet below the surface, and in some cases, it was a couple of inches above the surface during certain seasons of the year. The removal of this water from the trenches quickly, safely and economically, was one of the biggest problems in connection with the job. The power company's distribution lines paralleled approximately all of the trenches to be built at a distance of not more than two blocks.

The second photograph shows the discharge of an electrically operated eight-inch centrifugal pump operating in a man-hole at Tenth South and State Streets. The end of the portable sub-station supplying power is shown on the left-hand. Two pumps, one four-inch and one three-inch, were necessary at this point to handle the large quantity of water encountered. The trench is 16 feet deep and water was struck at a depth of four feet. Twenty pumping outfits, aggregating 117½ horse-power, were used on this job.

On Tenth South, where a 60-inch pipe was installed at a depth ranging from 12 to 16 feet, an electrically operating excavator was used, a cut of the hoist equipment of which is shown in the third photograph. An industrial track was laid along the trench on which this double drum hoist, operated by a 22-h.p. motor traveled. A dead man supporting the cable was located approximately 600 feet behind the hoist with a traveler operating on the industrial track between them at the point at which the excavating was being done. The hoist conveyed the buckets to the traveler, where they were lowered into the trench, filled, elevated and carried back and dumped beyond the point where the pipe had been completed, thus filling the trench. This outfit proved to be far more satisfactory than a similar steam equipment which was tried, due principally to the fact that the high speed steam engine shook the platform excessively. The cost of operating was considerably less, together with all the advantages of electric versus steam power.

Electric power was also used extensively by W. M. Gibson in the work which he did on West Third, Fourth and Fifth North Streets, Salt Lake City. Here the quantities of water to be handled were less than on the Ulen job. For that reason diaphragm pumps, both single and double mounting, were used, as they are better adapted for this purpose.

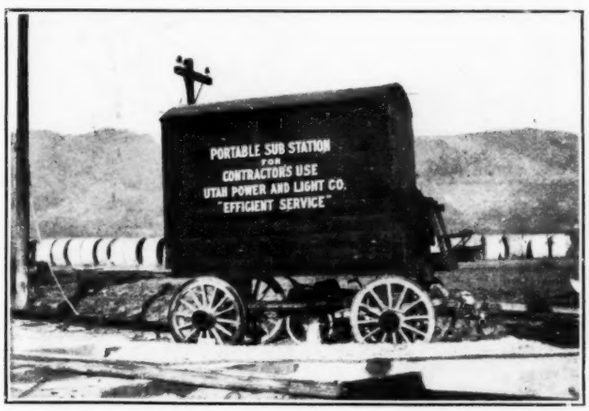
One photograph shows one of these equipments; a double diaphragm pump driven by a 3-h.p., 3-phase motor mounted on skids for easy handling. No electrically operated diaphragm pumps were regularly made so far as could be determined and the outfit here shown was developed for this purpose and its operation was entirely satisfactory. The outfit handles readily 100 gallons per minute. It has the advantage that it does not require repriming in case the water in the pump is exhausted, as do centrifugal pumps. Four 3-inch double-diaphragm and three 4-inch single-diaphragm pumps equipped as above, as well as one 3-inch centrifugal pump, were used on this job.

The latest and most extensive application of electricity to this kind of work is to be found in the contract recently awarded to Gibbons Bros., Reed & Roche for the construction of an intercepting sewer extending from Ninth North and Eleventh West to Tenth South and Seventh West, a distance of approximately 18,000 feet or 3.4 miles.

A sectional concrete pipe will be installed, the inside diameter ranging from 60 inches at its upper end to 78 inches at its outlet. This sewer pipe will be laid in a trench varying in width from 8 feet at its upper end to 11 feet at its outlet, with an average depth of 20 feet. The digging of this trench will require the removal of 150,000 cubic yards of earth. The northern end of the ditch passes thru a district containing underground water.

After studying carefully several different methods of handling the excavating of this trench and the laying of the

PORTABLE SUB-STATION *used to supply electricity of proper voltage to sewer construction machinery. Note reinforced concrete pipe sections in the background.*

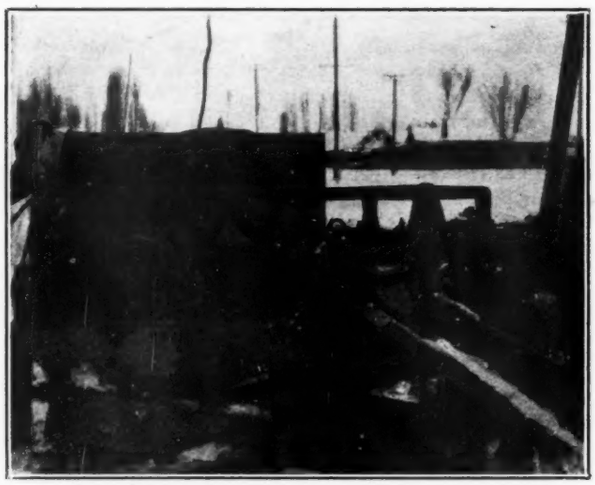


ELECTRICALLY DRIVEN CENTRIFUGAL PUMP *taking water from man-hole in 16-foot trench. The portable sub-station is at the left in the background behind the line pole.*

pipe, Gibbons Bros., Reed & Roche decided on the exclusive electric equipment herein described.

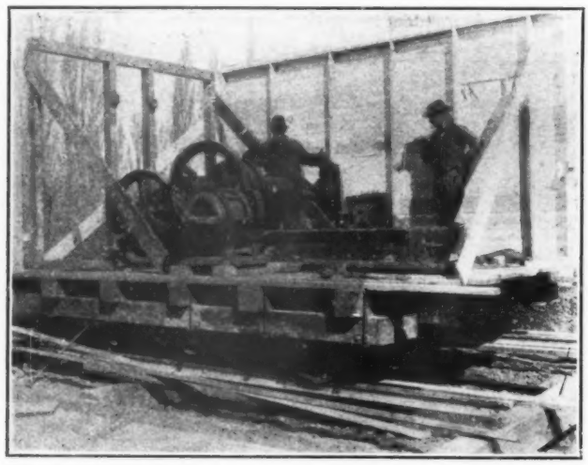
The Utah Power & Light Company had primary lines along the route of this sewer for most of its length. As the city will build a pumping plant at its terminus to lift sewage to the elevation of this gravity sewer outlet, the company built its transmission line along the sewer to its terminus for the remainder of the distance, which line is used to serve the excavating equipment. Two portable substations, each equipped with three 50-k.w. transformers are supplied, the one being used as a spare to be connected up ahead of the work, while the other is in service. Secondary cables consisting of two 400,000-circular-mill cables are run out from the substation a distance of approximately 800 feet either side. These cables are made up in lengths of 100 feet and are connected together by means of junction boxes at which points the various pieces of apparatus are connected to the secondary feeder as they move along the ditch.

The ditch is excavated to a depth of approximately 5 feet by means of horse-drawn scrapers. Beyond this depth it is not economical to use them. Sheet piling is then driven down using a pile driving traveler, which is seen in the foreground of the fifth photograph. This crane is equipped with two W-1 and two S-1 Sprague electric hoists. The two forward ones are of one-half ton capacity and handle the interlocking sheet steel piling. The two rear ones are of one-ton capacity and handle the compressed air hammers, which are used in driving the piling. These hoists are rope-controlled from the ground. Compressed air for operating the hammers is furnished by an Ingersoll-Rand compressor of 400 cubic feet free air capacity belted to 76-h.p. General Electric motor. This compressor outfit is mounted on a truck and wheeled along an industrial railway beside the trench as needed. The ¾-yard grab-bucket gantry cranes follow behind the sheet piling crane and do the excavating. One of these cranes is equipped with an orange-peel bucket, the other with a clamshell bucket. The former



DOUBLE DIAPHRAGM PUMP *electrically driven, pumping water from sewer trench, Salt Lake City, Utah.*

ELECTRIC HOIST *of sewer trenching machine on carriage spanning the sewer trench.*

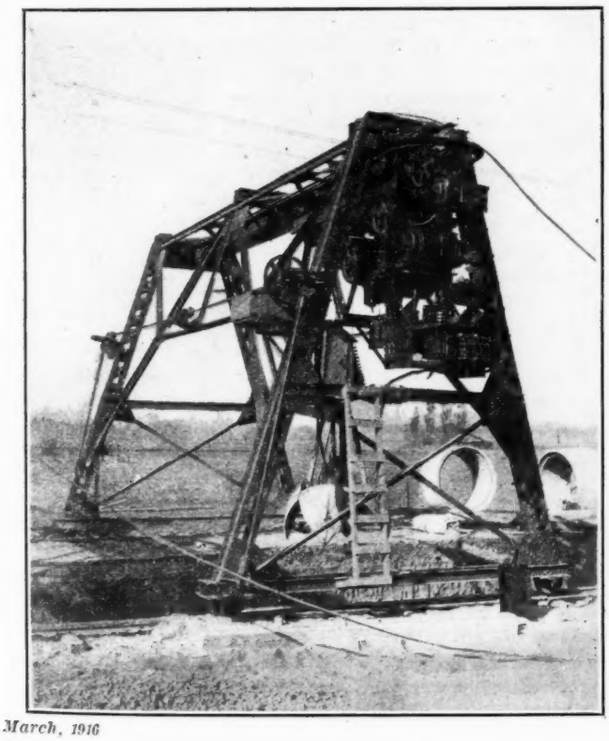


one is shown in the sixth photograph. These electric shovels, as well as the pipe-laying crane described later, were made by the Sprague Electric Works of the General Electric Company. Each of the digging cranes is equipped with four hoisting motors: A 10-h.p. motor operates the holding cables; a 22-hp.p motor operates the drum which closes the bucket, called the lacing motor; a 6-h.p.motor operates the cross travel of the carriage, and a 10-h.p. motor operates the longitudinal travel along the track.

At the present time the dirt is being hauled away from the excavators in horse-drawn carts, but it is hoped to work out some more efficient way of handling this feature. After the excavation is completed the pipe-laying crane picks up the lengths beside the trench and places them. This crane, shown in the last photograph, is equipped with a 30-h.p. hoist motor, a 5-hp.p. trolley motor and a 10-h.p. traction motor.

TRAVELER WITH ELECTRIC MACHINERY *spanning sewer trench. In foreground sheet piling is handled and driven by two electric hoists on two small travelers. In the rear are the digging and pipe-laying cranes with hoists for handling the orange-peel or clamshell buckets and the sections of pipe to be laid. The portable sub-station is seen on the right.*

NEAR VIEW OF DIGGING CRANE *showing the electric and hoisting machinery, the clamshell bucket and the method of moving the traveler along the trench.*



The electric equipment includes four vertical-shaft centrifugal pumps directly connected to 7½-h.p. motors which will be used in pumping water from the trench where needed. The aggregate connected load on this job is 265 h. p.

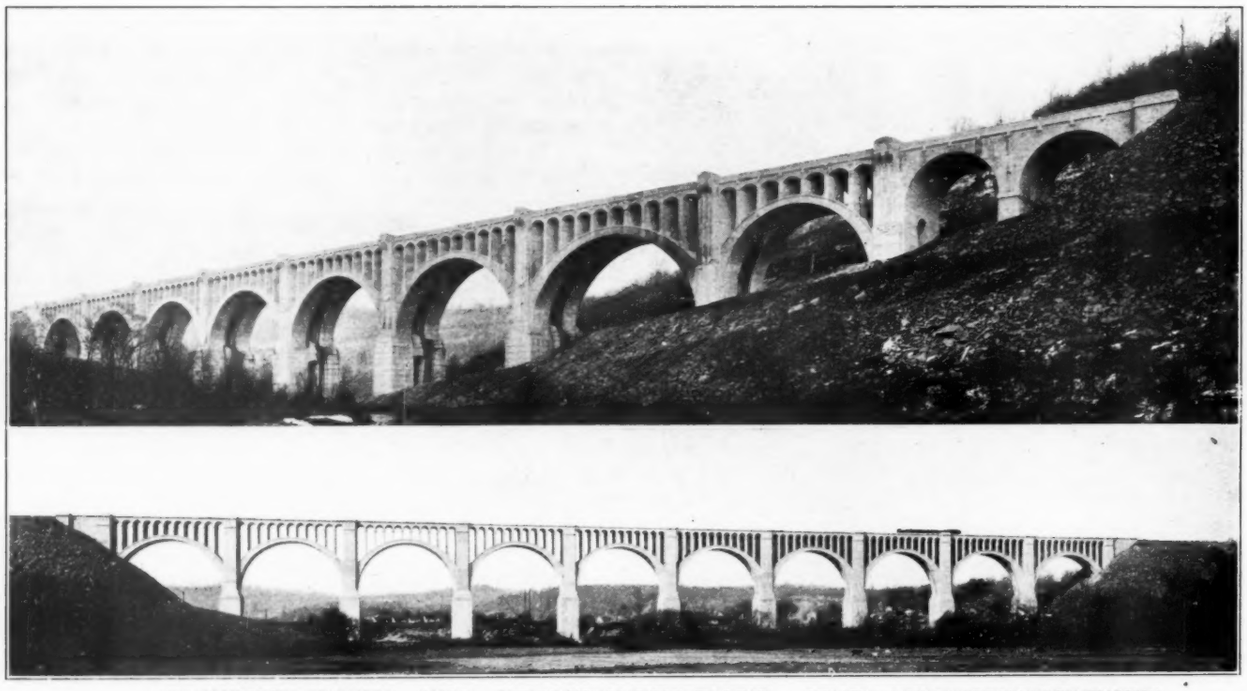
It is a little too early to get reliable information as to the current consumption per cubic yard handled, owing to the fact that the machinery is still stiff and the operators are inexperienced, but, all things considered the equipment is proving to be all that the contractors expected of it. They are confident that they will be able to do the job more economically than they figured in their estimates on which their bid was based. The power company estimated a revenue of $5,000 from the job, and the preliminary indications are that this estimate will be not far from correct.

NEAR VIEW OF THE PIPE-LAYING CRANE *showing electric hoist and a pipe on its way to the bottom of the trench.*

Lectures on Military Engineering

As a preliminary to service in a proposed reserve corps of engineers, a course of seven free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-General Leonard Wood, and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty.

Thru the cordial attitude and co-operation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. The lectures began on Monday, February 14, and continue thru February and March.



THE COMPLETED VIADUCTS. ABOVE: THE MARTINS CREEK VIADUCT. BELOW: THE TUNKHANNOCK VIADUCT.

CONSTRUCTION METHODS ON VIADUCTS

OF THE LACKAWANNA RAILROAD OVER TUNKHANNOCK AND MARTINS CREEKS

By C. W. Simpson, Resident Engineer, D. L. & W. R. R., Columbia, N. J.

The general features of these two rather spectacular viaducts on the new cut-off of the D., L. & W. R. R., to save a little distance and grade, are very familiar from frequent description and illustration. This article on the methods of building them used by the engineers and contractors treats the subject on the practical side and is of special value on that account. It is from a paper before the American Concrete Institute.

TWO large concrete structures, known as the Tunkhannock and Martin's Creek viaducts, have recently been completed by the Delaware, Lackawanna & Western Railroad Company, in connection with a grade improvement between Clark's Summit and Hallstead, Pa. Following is a brief outline of the structures, pointing out a few of the more essential features of the planning and carrying out of the work of construction.

Martin's Creek Viaduct.—The Martin's Creek viadust is a three-track bridge having a maximum height above stream-bed of 150 feet and a length of 1,600 feet. It has two 50-foot and two 100-foot semi-circular arches, and seven 150 by 59-foot three-centered arches. The larger arches are 6 feet wide, spaced 29 feet 6 inches center to center, which carry transverse spandrel walls supporting an arched floor system. This structure required about 26,000 cubic yards of foundation excavation, 77,000 cubic yards of concrete and 1,600,000 pounds of reinforcing steel. The completed bridge is shown in an accompanying photograph.

Tunkhannock Viaduct.—The Tunkhannock viaduct is a two-track bridge composed of ten 180-foot and two 100-foot semi-circular arches springing from solid piers and supporting transverse spandrel walls, upon which rests a floor system composed of 13-ft. 6-in. semi-circular spandrel arches. The deeper piers have a section 40x46 ft. below the ground surface and all piers are 36 ft. 6 in. by 43 ft. 6 in. to a point 17 feet below the springing line of the main arches. At this elevation a 4-ft. 3-in. offset provides a seat for the temporary steel centering. The deepest pier extends 103 feet below the original ground surface, and at this pier it is 309 feet from the bottom of the foundation to the highest point of the masonry. Each main arch is composed of two ribs, 8 feet thick at the crown and 14 inches wide. About 163,000 cubic yards of concrete, 2,500,000 pounds of reinforcing bars, and 48,000 cubic yards of foundation excavation were required. All piers were carried to solid rock, the depth of which had been determined by borings. The completed bridge is shown in one of the photographs.

The natural conditions at the site of each of these structures and the method of carrying out the construction work (with one exception) were so nearly identical that a description of the Tunkhannock viaduct will apply equally as well to the Martin's Creek. The exception noted is that the Martin's Creek bridge was constructed entirely with derricks, while at the Tunkhannock bridge both derricks and a cableway were used. The reason for the use of a cableway at the latter structure was its height and the length of the spans.

GENERAL PLAN OF PROCEDURE.

The contract for this work was let in June, 1913, and the time set for completion was July 1, 1916.

In planning the work no detailed schedule was laid out, but the following general plan of procedure was determined upon.

Of the thirteen foundations, six were more than 40 feet deep, and steel sheeting was adopted for these six excavations. At three of these and at three of the other foundations, the configuration of the ground was such that a portion of the excavation could be accomplished with a steam shovel. Of the other three deep foundations, two were partly in the bed of the stream and were considered to be the most difficult. It was decided to provide sufficient sheeting for these two piers; to start them at the earliest possible date; and to re-use this sheeting at the other four deep excavations. In the meantime the steam shovel excavation was to be carried out and the other shallow piers excavated.

In planning the concrete schedule it was necessary to consider that the mixing plants would be on low ground, while five of the shallow excavations were in much higher ground and could be reached economically only by the use of the cableway. For this reason, no large amount of concrete could be placed until either the cableway or some of the deep foundations were completed. It was estimated that of the excavations accessible without the cableway, four (two shallow and two deep) could be completed on or before January 1, 1913, and the concrete schedule was made out from that date, as the cableway could not be ready for use before February.

These conditions made it necessary to contemplate the placing of 163,000 cubic yards of concrete in thirty months. It was, of course, recognized that concreting could be carried on much more rapidly and continuously while working on the foundations and on the main pier shafts than would be the case when working on the arch rings and spandrel system. About half the concrete, or 80,000 cubic yards, is below the springing line of the main arches, and it was decided that this quantity must be placed during the first ten months, or at the rate of 8,000 cubic yards per month. This made the rate for the remaining twenty months 4,200 cubic yards per month.

It must not be understood from this that it was the intention to complete all the work below the springing line before proceeding with the superstructure. On the contrary, it was desired to combine work on the superstructure with the part below the springing line as much as possible; but it was realized that the pier work must predominate during the first third of the allowed time. Also, it was not expected to maintain a uniform monthly rate. The schedule was simply a general guide as to the sufficiency of the plant and forces engaged.

The organization of forces was as follows:

A general manager was in complete control. To him reported a superintendent and an office manager. A timekeeper and a material clerk reported to the office manager regarding office matters and to the superintendent regarding field matters. The superintendent's assistants were as follows: Master mechanic, general carpenter foreman, foreman rigger, foremen of concrete gangs, foremen of excavation gangs, mixer foremen, foreman of material gang and foreman of steel gang. The master mechanic was in charge of all machinists, enginemen, hoist runners, cableway runners, steam shovel men, pumpmen, drill runners, blacksmiths, signal men and electricians. The carpenter foreman had under his direction subforemen, mill-men, carpenters and helpers. The rigger foreman was responsible for the condition of the cableway and derricks. The duties of the other foremen are evident from their designation. Laborers and sometimes foremen were shifted from one class of work to another as occasion demanded, but all men were kept at the same work so far as possible.

GENERAL LAYOUT.

Before the completion of the improvement the main tracks of the Delaware, Lackawanna & Western Railroad were approximately parallel with and about 450 feet distant from the viaduct. The railroad company's tracks were on an embankment, so that they were about 60 feet higher than the creek bed and about 35 feet higher than the ground level at the mixing plants. The loop formed by the narrow gage track encloses a knoll about 30 feet higher than the general level of the valley. On this knoll are located the machine and blacksmith shops, superintendent's office and water tower. The general office and hospital are located on ground at about the same elevation as the knoll above mentioned. The general material derrick is located on a narrow ridge which connects the railroad embankment with the knoll at the blacksmith shop. A similar ridge extends from pier 6 to the high ground at the hospital. Cuts were made thru these ridges to permit the laying of the 3-foot gage tracks.

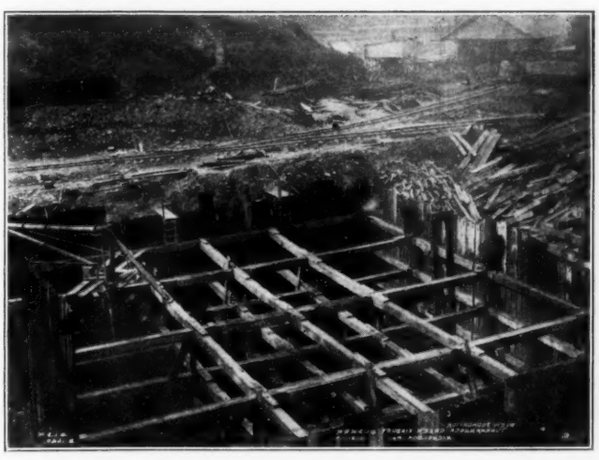
The first operation was the widening of the railroad company's embankments and the laying of track for empties and loads. This track was completed on June 12; a track pile-driver immediately started to construct the material trestles; the general material derrick was erected; work was commenced on the shops, storehouses and office buildings, and a narrow-gage track was laid from the material derrick to pier 4. During July a steam shovel started foundation excavation, and sheet piling was being driven at pier 4. During August the erection of the cableway was started; a trestle carrying a narrow-gage track was built across the creek to give access to pier 3, and a large amount of plant and supplies were delivered on the ground.

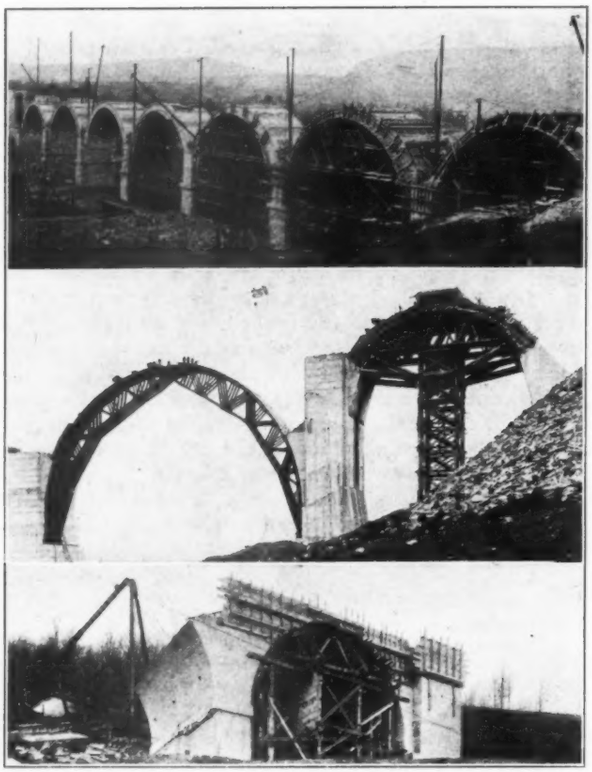
FOUNDATION EXCAVATION.

A steam shovel having a 1-cubic-yard dipper excavated piers 5, 6 and 8 down to ground-water level and piers 2, 9 and 10 down to rock. The material was allowed to take its natural slope, and the excavations were made sufficiently large to take care of the raveling of the banks prior to the completion of the piers. The shovel loaded the material into 4-cubic-yard cars, and it was utilized in grading for the narrow-gage tracks and in bringing all low ground between the creek and the railroad up to a level with the mixing plants. All the ground around the sawmill, laying-out platform, steel rack, boiler house, and mixer 2 was "made" in this way. This "leveling up," amounting to as much as 12 feet in some places, was done at practically no extra cost and proved a very great benefit in handling the work. The shovel completed its portion of the excavation in December, 1912, having excavated about 50,000 cubic yards, 15,000 cubic yards of which was pay material.

In excavating below water level, interlocking steel sheet piling in length of 30 feet were used. The sheeting was driven with a 3-ton steam hammer and was braced with 12x12-inch

PIER FOUNDATION *for Tunkhannock Creek viaduct of the D., L. & W. R. R. at Nicholson, Pa.*





METHODS OF CENTERING *and of supporting Centers and Forms.*

ABOVE: *Centering and supporting of centering on the Paulinskill viaduct, where similar methods were used. The various stages of forms for constructing the arch rings are shown also, from the placing of the outside forms, on the right, to their removal, toward the left. At the far left are seen the forms for constructing the secondary arches.*

CENTER: *Two styles of centers for arches used on the Tunkhannock Creek viaduct, one of steel for a 180-foot span and one of wood for a smaller end span with high pier.*

BELOW: *Arch center and frame used on the east end arch of the Martins Creek viaduct.*

timber. Sheeting was required for depths of from 50 to 75 feet, necessitating the use of two and three lengths of sheeting.

The method of procedure with the excavation was to erect one set of sheeting on lines about 3 feet outside of the required foundation area, and to drive the sheeting as far as convenient. The excavation was then carried down to the bottom of the sheeting by means of 1½-cubic-yard clam-shell buckets, operated in the bays between the timber braces, which were so spaced as to admit the operation of the bucket. The bracing was put in on about 5-foot centers, vertically, as the excavation proceeded.

After the excavation had been carried down to the temporary bottom of the sheeting, the latter was driven farther, and the operation was repeated until the top of the sheeting was down to the ground surface. Another set of sheeting was then erected about 6 feet 6 inches outside the first set, and was driven as deep as was thought advisable. The material between the two sets of sheeting was excavated with the clam-shell bucket; the first sheeting was then driven farther; and the excavation was resumed. As the inside set of sheeting was driven down, the upper set of timber bracing was removed and placed at the bottom. The process was continued until bedrock was reached. Almost all of the sheeting was recovered, some of it being used four times.

Two of the piers gave serious trouble on account of quicksand. The difficulty was overcome in one of these by dividing the last 12 feet of the excavation (the total depth was 62 feet) into three pockets and taking each pocket down separately. A somewhat similar plan was tried in the other excavation but was not successful, and it was necessary to resort to compressed air. A caisson was built inside the sheeting with its cutting edge 45 feet below the top of the excavation and 32 feet above bedrock. The two lower sets of bracing timbers were built into the caisson and were carried down with it. Concrete was placed on top of the caisson as it sank in the usual manner. Had it not been for the difficulties that had to be overcome in excavating for this pier, the work would have been completed well within the contract time. This excavation was not completed until February, 1915, and yet the entire bridge was completed in September, less than three months later than the contract time.

CONCRETE PLANT.

Sand and stone were delivered on the material trestles in bottom-dump hopper cars and dumped into the storage piles. Each mixing plant was served by two derricks which operated clam-shell buckets of 40-cubic-foot capacity. These derricks conveyed the sand and stone from the storage piles to small bins over the mixers. From these bins the material passed by gravity into a measuring hopper where the cement was added. From the measuring hopper the material passed by gravity into a 2-cubic-yard mixer, which dumped directly into double-line bottom-bump buckets on flat cars. Twelve-ton locomotives hauled trains of three flat cars, one car being empty to receive the empty bucket from derrick or cableway. At mixer 1 the cement was conveyed from the original cars on the material trestle to the hopper floor of the mixer by the sand derrick. At mixer 2 the cement was unloaded from the cars into chutes, which conveyed it to the hopper floor. All cement was shipped in cloth. A cement house of 3,000 barrels capacity was built and filled, but no cement was used from this source except when shipments were delayed and no cement was available in cars.

The mixing requirements made it necessary to turn each batch from 2 to 2½ minutes and limited the mixer output to an average of seventeen batches per hour. Each mixer gang consisted of one foreman, two derrick operators, one mixer runner, one fireman and eleven laborers. Two trains, each requiring one engineman and one laborer, served each mixer. One foreman with from eight to sixteen laborers spread the concrete in the forms. The above organization, with the addition of cableway runners and signal men, averaged about 30 cubic yards of concrete per hour.

The following table gives the cubic yards of concrete placed during each month. It is interesting to compare this with the original schedule.

	1913	1914	1915
January	8,410	3,400	2,000
February	5,740	2,260	5,130
March	4,520	1,460	5,620
April	6,630	5,090	4,010
May	7,190	3,270	3,200
June	13,890	4,010	3,400
July	12,150	4,770	4,000
August	8,810	4,450	1,800
September	3,820	4,910	
November	3,270	4,310	
December	2,160	4,000	

About 8,900 car loads of sand stone and cement were

handled on the material trestles and 1,200 car loads of other material were handled by the general material derrick.

DERRICK AND CABLEWAY.

Derricks were operated by three-drum, 8¼x12-inch hoisting engines with swinging gear attachments. Masts were about 90 feet and booms 85 feet long. In a few cases derricks were erected on timber pedestals or pile clusters about 25 feet high, but in most cases they were set at the ground level, and all work above their reach was carried on by means of the cableway.

The cableway consisted of two lines of 2¼-inch main cables, spaced 20 feet apart and supported by end towers about 160 feet high and an intermediate tower 300 feet high. The end towers were 3,028 feet apart and the intermediate tower divided this distance into two spans of about equal length. Four engines and carriages operated as four independent units. The towers were of timber and the intermediate tower was so located and designed that the arch rings and all the floor system except a narrow slot, could be constructed thru it and thus utilize the cableway to the fullest extent.

The last centers to be erected were those passing thru the center tower. The adjacent piers were carried up to the top of the floor before these centers were erected and two stiff-leg derricks were located on each pier. After these last centers were erected, all material was raised above them by the derricks and then transferred to the cableway for transportation to its destination.

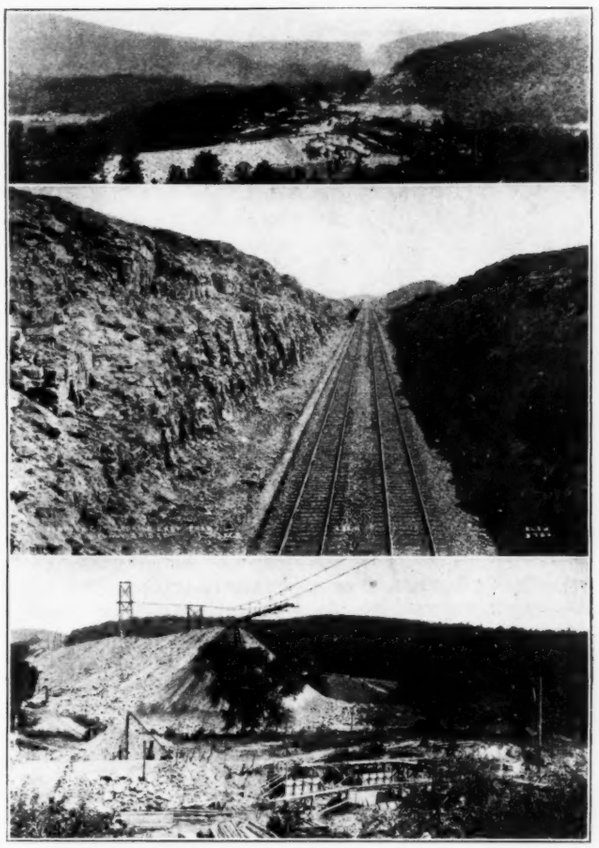
ARCH CENTERS.

Five sets of three-hinged steel arch centers were used in constructing the 180-foot spans. Each set was composed of four ribs weighing 47 tons per rib, spaced 3 feet 10 inches center to center, and provided support for one of the two concrete ribs composing each span. A 4-foot 3-inch ledge or offset, 17 feet 6 inches below the springing line of main arches, was provided to support the centers. On this offset rested an I-beam grillage extending the full width of the pier and carrying 6-inch rollers on which the pedestals of the centers rested. For erection purposes each steel rib was built in four sections.

Before the centers were erected the adjacent piers were constructed to an elevation about 37 feet above the spring line, forming what is termed the "umbrella." The procedure of erection was as follows: After the I-beam grillage, rollers and pedestals were in place, the lower quarters of the ribs were raised to position, the bottom pins driven and the top of the sections anchored to the "umbrella" tops by bolts passing thru the concrete. One of the upper quarters was next raised to position and bolted to the quarter already in place. The other upper quarter was then put in position, bolted to its lower section and the crown pin driven. The ribs were so designed that the half rib would support itself as a cantilever. Fig. 6 shows two sets of centers in place and the lower quarters of another set erected. Fig. 5 shows the upper quarters being erected thru the center tower.

To provide for striking the centers or adjusting the crown elevation, the first panel on each side of the crown pin was constructed with pin connections, and the web member at right angles to the chords consisted of two parts connected by a right-and-left thread screw operated by a lever and ratchet. By lengthening or shortening this member the distance between the crown and end pins was decreased or increased, thus lowering or raising the crown.

After serving their purpose under one rib of a span, the centers were slacked off and jacked over to their position under the twin rib. When the span was completed, the centers were rolled back under the opening between the concrete ribs and transported to their next point of service. In constructing the last two spans, centers were erected under both ribs simultaneously in order to hasten the completion. Timber centers



VIEWS *showing the extent of cuts and fills where they were chosen instead of viaduct construction.*

ABOVE: *The Lubber Run and Wharton fills, looking west.*

CENTER: *The Van Horn cut, looking east.*

BELOW: *The east end of the Pequest fill at Andover, N. J. Note the railway track supported by cables, onto which cars are backed by con motive and there dumped.*

resting on a timber tower were used for the 100-foot spans. The type of construction of these centers is shown in the right-hand span in the photograph of Tunkhannock viaduct in the group showing the various methods of supporting forms in use on the two viaducts, which also shows the placing of lagging on a set of steel centers.

FORMS.

With very few exceptions the forms were built on the ground in sections and hoisted to position by cableway or derrick. These sections were re-used a great many times, some of the first ones built being still in service at the end of the work. To illustrate the construction and utility of this type of form a description of the forms used for the main pier shafts will be given in some detail. These sections were of two sizes, one being 18 feet 3 inches and the other 15 feet 8 inches long, and both were 17 feet 9 inches high. The larger section weighed about 7,000 pounds. Four of the larger and six of the smaller sections were required to surround one pier and were termed a set. Four sets sufficed to construct all the piers up to the centering ledge without in any way retarding the progress of the work and, with slight alterations, these same sections were used up to the tops of the piers and also as spandrel wall forms.

Each section is made by nailing two layers of 1x8-inch

tongue-and-groove boards to 8x10-inch horizontal studs spaced 2 feet 5 inches on centers, one layer being at right angles to the other and both layers at 45 degrees with the studs. The studs were bolted to 10x10-inch verticals which extended about 2 feet above the planking. All forms were faced with No. 26 galvanized sheet iron and, in some cases, paper was laid between the layers of boards as an aid in protecting the concrete during freezing weather. The forms were kept in position by rods running down at an angle of 45 degrees from the vertical posts to anchors in the concrete and by 12x12-inch timbers resting on the top edge of the planking and wedged against the verticals. The rods were provided with a threaded sleeve joint so that the projecting end could be removed from the concrete.

Six carpenters with two cables or one derrick would remove and re-erect one set of forms in somewhat less than two days. On two occasions when the plant was available and it was desired to move the forms with as much speed as possible, sixteen carpenters, with the aid of two derricks and two cables, removed and re-erected a set of these forms in seven hours.

The forms for the arch rings were very similar in construction to the pier forms, and two sets, that is, forms sufficient to cover two complete ribs, sufficed for the entire work.

The main arches were constructed with large blocks or vouissoirs separated by small keys. The block forms were made entirely separate from the key forms.

These structures were designed and built under the direction of Mr. G. J. Ray, chief engineer, and Mr. F. L. Wheaton, engineer of construction. Mr. A. B. Cohen was in charge of the design and the writer was resident engineer in charge of the construction of the Tunkhannock viaduct.

The contractors were Flickwir & Bush, Inc., for whom Mr. F. M. Talbot was general manager and Mr. W. C. Ritner, superintendent.

RAILWAY IN BRICK HIGHWAY CONSTRUCTION

The use of a standard-gage temporary track to assist highway construction has been the subject of successful experiment by contractors Swank and McIntyre in building six miles of brick highway from New Lexington in the direction of Somerset, O. All materials were hauled directly onto the job, including screened gravel, sand, cement and brick. One thousand cars were handled in the course of these operations. Thus there was only one handling of the material after it was loaded at the various supply points.

A 50-ton geared steam locomotive was used to pull the cars over a spur built entirely upon new right-of-way. The track, which is standard gage, was constructed with 60-pound relay rails. Sixty per cent. of the ties are railroad unspiked discards and are used only to furnish bearing. The remainder are standard ties which hold the gage.

Some trouble was anticipated, due to the possibility of the track settling on new fills. As a result, the ties on the fills were spaced closer and 3 or 4-inch saplings were placed under the ties parallel with the rails. However, the fills are few and all are short. The track is laid just outside the limits and parallel with the curb of the new road.

A number of 4, 5 and 6 per cent. grades are encountered.

For the concrete work a train, consisting of one car of screened gravel, one car of sand and one of cement, was kept moving alongside the Koehring paving mixer. The original intention was to use a tank car for hauling water for the concrete work, but owing to the heavy grades it was decided to pipe the water and thereby relieve the work of the locomotive.

The gravel car was spotted directly opposite the mixer. A batch hopper was hung on the side of the car and is loaded while the mixer skip is discharging into the machine. When the skip is lowered to the ground a gate in the batch hopper is opened and gravel is shot into the skip. The sand car is pushed ahead of the gravel car, and sand is unloaded thru a chute into wheelbarrows. The cement is unloaded from the cement car and distributed along the line of the work. One man is kept busy dumping cement into the skip.

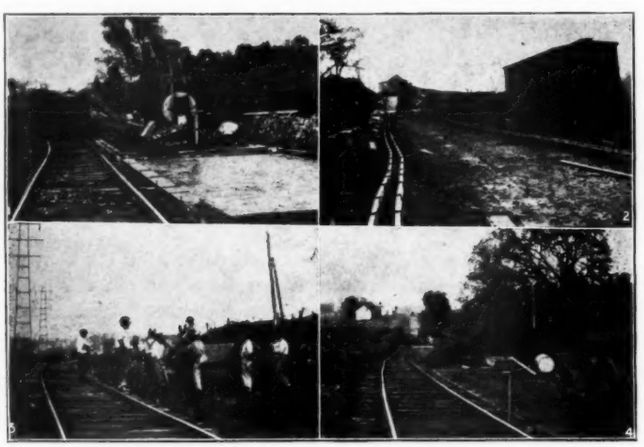
The cars of brick are unloaded by carriers and laid directly from the car. High speeds are not needed and considerably fewer trips were necessary than with other common methods of transportation.

The following table indicates a haulage cost of 12 cents per ton-mile:

TOTAL AND TON-MILE HAULING COSTS.

First Cost—		
New hardwood ties, 4,000 at 32 cents	$1,280	
Old ties from railroad, 12,000 at 10 cents	1,200	
Relay rail, 60-pound, 550 tons at $17	9,350	
Labor laying and removing track, 32,000 feet 15 cents	4,800	
Locomotive	4,500	
		$21,130
Operation, 8 months at $250		2,000
		$23,130
Salvage—		
Scrap rail, 550 tons at $13	$7,150	
Locomotive	1,500	
		8,650
Net cost		$14,480

One thousand cars or 40,000 tons hauled an average of 3 miles equals 120,000 ton-miles. Cost per ton mile, 12 cents.



TRANSPORTING PAVING MATERIALS *direct from cars to pavement. Road at New Lexington, O.*

Illustrations courtesy Engineering News.

WORKERS IN THE FIELD

The Lorimer Bridge, Piqua, Ohio

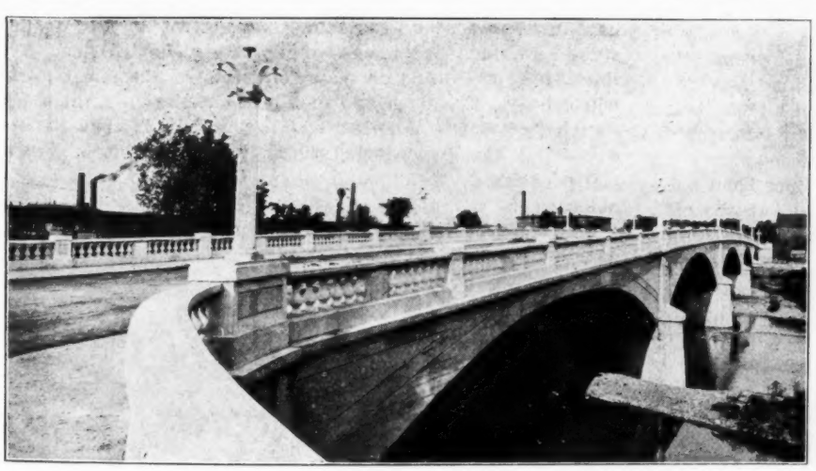
Following the disastrous floods in 1913 thruout the Miami valley, several bridges in Miami county were found to be so badly damaged that reconstruction was almost impossible and efforts were made to have at least two bridges constructed of cement. Public opinion at the time was against such a construction, but through the efforts of Mayor G. W. Lorimer of Piqua, the county commissioners were finally interested in the construction of a concrete or cement bridge.

After much effort by the mayor and other public spirited citizens rough plans were drawn by Mayor Lorimer for the construction of such a bridge and the plans were submitted to the Hackedorn Contracting Company, of Indianapolis, Ind. The plans were immediately approved and recommended as being the best possible for the location of the bridge at Union street.

The bridge as recently completed over the Great Miami river, is shown in the accompanying photograph and is one of the most artistic concrete bridges in the country. It is approximately 600 feet long, comprises four arches, and has a width of 50 feet. It is all concrete including electric lamp standards. All of the railing and ornamental work above the coping are made of cast concrete, using as an aggregate, marble grit, ground marble and Medusa White Portland Cement.

At night the bridge is illuminated by large tungsten lights, and the white texture of the ornamental work stands out strongly both day and night.

LORIMER AVENUE BRIDGE, *Piqua, O., an artistic reinforced concrete bridge with concrete railing and ornamental work.*



Specification for Four-Inch Granite Paving Blocks

To Editor of MUNICIPAL ENGINEERING:

Sir—For several years past the city of Chicago has been laying granite blocks only 4 inches deep, and has gotten very satisfactory results.

It seems to us that they are following a well known engineering principle, viz., using no more material for a given service than the service actually demands, allowing a sufficient factor of safety. In street paving there are two factors to be considered, viz., the foundation and the wearing surface. The use of the old deep granite block was an attempt to combine both in one, and was bad engineering. Nowadays no engineer thinks of putting down a pavement without providing an adequate concrete base, and having done this, it should be his care and study to provide a wearing surface that will be as nearly permanent as possible, and with as little waste of material as possible.

It must be evident to any one that a wearing surface 4 inches thick of granite having a reasonable degree of toughness and compressive strength meets every requirement, and if a block of greater depth is used part of it may be considered as belonging to the foundation. In this case, use for foundation purposes is being made of a high priced material, whereas concrete, which is much cheaper, would answer as well.

In the field of mechanical engineering bearing or wearing surfaces are supplied with comparatively light removable bushings of high grade material which can be renewed when they wear out without disturbing the heaving casting of cheaper material which goes to make up the bulk of the machine. That is good engineering. Why not apply the same principle to road engineering, and use the following specification for heavy or light traffic streets?

The paving blocks shall be of medium grained granite, free from an excess of mica or feldspar, showing an even distribution of constituent minerals, of uniform quality and texture, showing no seams or evidence of disintegration, and a crushing strength of not less than 30,000 pounds per square inch, and a factor of toughness of not less than 12, as determined by the methods employed at the United States Department of Agriculture, Office of Public Roads.

The blocks shall be of the following dimensions: 3¾-in. to 4¼-in. wide, 3¾-in. to 4¼-in. deep, and 7-in. to 10-in. long. The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be

laid with joints not exceeding ½-in. in width at the top and for 1-in. downward therefrom, and not exceeding 1-in. in width at any other part of the joint. The top surface of the block shall be so cut that there will be no depressions measuring more than ⅜ of an inch from a straight edge laid in any direction on the top and parallel to the general surface thereof.

Not more than one drill hole shall show on the head of the block and none on the ends. An allowance of not over an average of one block showing drill hole on the side, will be permitted to a square yard of pavement.

That would provide a wearing surface of great durability, and one that can be replaced economically if it were found desirable to do so at the end of 25 or 30 years' service. A block of that size can be cut economically, and have close joints and smooth heads. It would cost less than the larger block and would produce a smoother pavement.

Of course, attention must be paid to the physical properties of the granite used, or the whole purpose would be defeated. A granite that is structurally weak is no better for paving purposes than a vitrified brick. This feature, however, can be taken care of by drawing suitable specifications.

The old specifications which called for a deep block were based on the assumption, we presume, that almost any kind of material classed under the general name of stone might be used, regardless of its physical properties. Would it not be well to draw an alternate specification, allowing the use of a block of 3¾ to 4¼ inches, provided the granite has a toughness of not less than 12 and a compressive strength of not less than 30,000 pounds per square inch, and take bids under these specifications as well as under the present standard specifications.

THE HARRIS GRANITE QUARRIES COMPANY,
Salisbury, N. C.

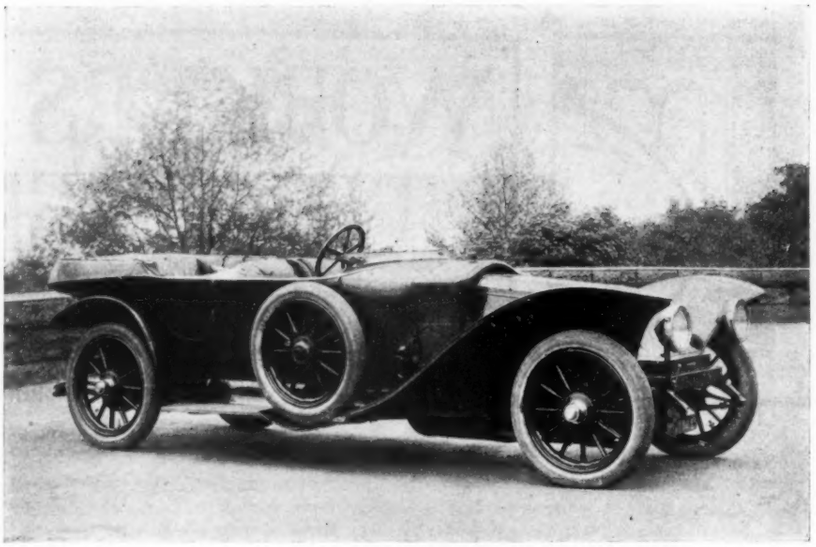
This Bid Was Not Legal

The Editor of MUNICIPAL ENGINEERING:

Sir—In the current issue of your magazine you publish a few paragraphs under the caption "Is the Bid Legal?", calling attention to the awarding of a contract by the city council of Iowa City, Ia., to William Harrabin, who offered to construct a bridge for $500 less than the lowest bidder for the contract. Since you ask the question "Is the bid legal?", perhaps you will be interested to know that in January, 1915, the city of Cumberland, Md., received a similar proposition in connection with an offering of an issue of $150,000 paving bonds. A number of bids were received from bond houses, the highest being an offer of 99.31 for the bonds. One of the bond houses, in addition to submitting a bid of 98 for the issue, made an alternative bid, in which it agreed to pay $1.00 per bond more than any other bid or combination of bids made to the city. This alternative bid was accepted by the city, over the protest of the other bidders, who asserted that it was illegal. A taxpayer's suit was brought by Henry Shriver, attacking the bid and the award on the bid as illegal and seeking to enjoin delivery of the bonds. In an opinion handed down by Judge Henderson, at Cumberland, Mr. Shriver's contentions were upheld and a permanent injunction restraining the delivery of the bonds was granted.

The Iowa City, Ia., case seems to involve exactly the same question as that thrashed out in the Maryland courts and this letter may, therefore, be of interest to your readers.

THE BOND BUYER, SANDERS SHANK, Secretary,
New York City.



MOTOR CAR *with concrete body.*

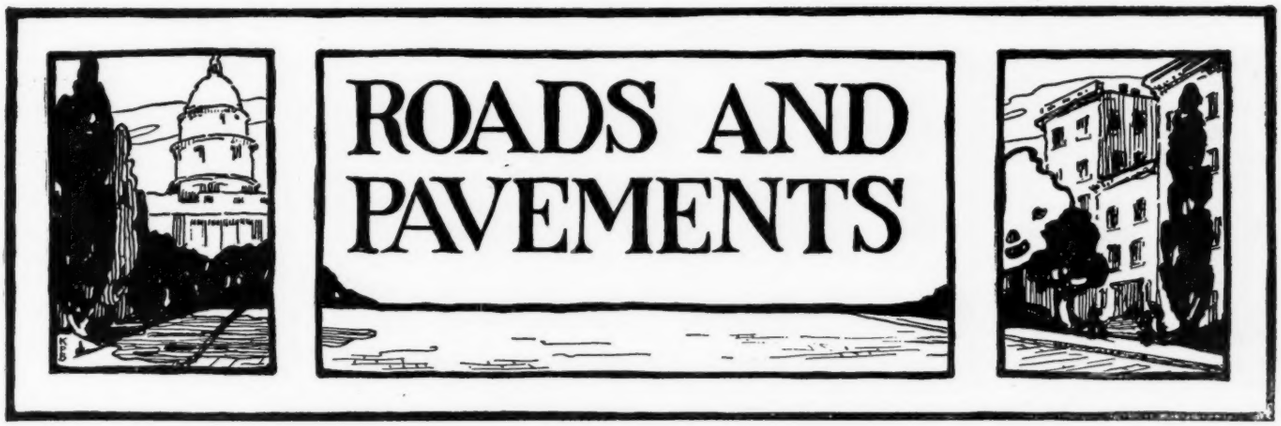
Renault Touring Car With Concrete Body

The Renault 50-horse power, 6-cylinder touring car shown in the accompanying illustration is distinguished by a concrete body, which the makers say will resist wear and retain its beauty far better than wood or metal.

The car is the most powerful and speedy built by the well known firm of Renault in their famous factory in France, and is very light and strong. It has created a great deal of interest not only among the auto manufacturers, but also with the buyers in New York, and is the only one of the kind ever received in this country.

The body construction is very novel as the coachmakers have used cement or concrete laid on wire netting or lath similar to that used in concrete building construction. The lines are graceful and no seams or joints can be found in the whole body. The dash and moldings are the only parts constructed of wood. Another striking feature is that the top completely disappears inside the body. The cushions are specially designed, with elastic supports, and are stuffed with eiderdown.

This clearly indicates that the value and possibilities of concrete construction are still undeveloped to a large extent.



Influence of Permanent Roads on Motor Truck Haulage

By S. M. Williams, Sales Manager The Garford Motor Truck Company.

The day is past when the motor truck is looked upon as an experiment. Its value in the delivery of road materials has been proven beyond any doubt, but its selection should be surrounded with every consideration. Unfortunately it has not proven practical or economical in some cases, but in the majority of these the blame was upon the purchaser and sometimes an overzealous salesman, rather than the motor truck. The same size or capacity of truck will not work successfully under all conditions. Consequently the capacity which determines the weight must be considered along with general road and bridge conditions over which the truck will be required to operate.

Again, the loading facilities are not given proper consideration, and frequently the motor truck is operated with the same loading methods as formerly employed in team hauling. The regularity with which the motor truck is operated determines its economy. Consequently loading facilities should be provided, so that little time is lost and the truck kept in as nearly continuous motion during the working hours as possible.

The motor truck, under proper conditions, is reducing the team haul cost from one-third to one-half. In a recent conversation with a prominent contractor operating in the East, he said: "I have about two hundred horses in daily use, but I feel from my experience that the motor truck will soon replace the horse method of transportation."

During the last few years I have personally studied and made several investigations for the purpose of ascertaining the influence of road conditions upon the marketing of the motor truck.

In one state I made a canvass by mail, addressing all probable purchasers, and received over one hundred requests for data concerning the construction and operation of the motor truck.

Upon further investigation I found that there was not a single case where the business of the inquirer did not justify the purchase of at least one truck, but not more than five of the total number could be assured of dependable service from any truck, on account of the miserable and unreliable road conditions. Consequently they could not afford to purchase the truck for dry weather and be compelled to maintain their mules for wet weather.

Early last year we began to gather the names and addresses of those state and county officials thruout the entire United States whose duties brought them in contact with road construction, including the county judges, county commissioners, engineers and road supervisors. While gathering this list we prepared a small illustrated booklet with a view of telling the story of good roads value in the simplest manner.

After securing the complete list of officials, some 20,000, we mailed a letter to each official, inclosing copy of the booklet, and stated if they believed the mailing of the booklet to citizens of their communities would assist in the creation of good roads sentiment, we would be pleased to mail it, without charge, upon receipt of the names and addresses, for which we furnished blanks, also a stamped addressed envelope for their convenience in replying. In this manner our distribution of the booklet is running into hundreds of thousands and they are going into the homes of the farmers and others, among whom there are thousands who do not have the privilege of reading the periodicals devoted to road improvement.

In addition to the distribution as originally planned, and which I have described, we are receiving daily requests from good roads associations, chambers of commerce and county officials for quantities of the booklet to be used in good roads campaigns, and there are now in the United States more than twenty campaigns for bond issues for one-quarter to one million dollars, in which the booklet is being used as campaign literature.

We are going even farther where campaigns are under way: we are also furnishing cuts of the illustrations shown in the booklet, so that they may be reproduced in their county newspapers—and our work does not end there. We believe that one of the greatest steps for final and permanent road improvement is to educate the youth of to-day, who is the citizen of tomorrow, as to the true meaning of good roads.

To encourage the teaching of the subject we are co-operating by furnishing, without charge, copies of the booklet to all schools willing to take up the subject.

We have already had requests for supplies of the booklet from a large number of educational institutions, and as an example, we have furnished the state superintendent of the schools of Alabama 3,400 copies for distribution to the public school superintendents thruout the state, and since their distribution we have been receiving requests from the teachers themselves for their individual requirements.

The good roads associations and other organizations have invariably offered to pay for the booklet, but in no case have we accepted any money, regardless of quantity shipped.

We recently addressed a letter to every automobile dealer in the United States—about 20,000—enclosing a stamped addressed envelope for the return of a list of questions prepared for showing the road conditions in each territory, and their influence upon the promotion of both the motor truck and motor car business, as considered by the individual dealer in that territory.

To one who has not given the matter consideration, the replies would be almost astonishing, and more so when you realize the little interest shown on the part of the industry

toward the improvement of such conditions. Of a total of 3,542 replies received, 902 stated that the roads in their territory were from "Fair to Good;" 2,640 stated, "Fair to Bad," and "Fair" only during dry weather. Showing the influence of road conditions upon the economic use of the motor car and motor truck, 943 dealers replied they believed that from 25 to 50 per cent. of the year the use of the motor car and motor truck was practically prohibited in their territory; 611 from 50 to 75 per cent.; 259 from 75 to 100 per cent.; 1,177 dealers state that permanent roads in their territory would enable them to increase their sale of motor cars and motor trucks from 25 to 50 per cent.; 687 dealers from 50 to 75 per cent., and 276 from 75 to 100 per cent.

More enlightenment is needed as to the necessity of building permanent roads that will not only invite, but will withstand the abuse from heavy traffic unknown a few years ago, and it is also important that the public should be educated as to the value and necessity of proper road maintenance.

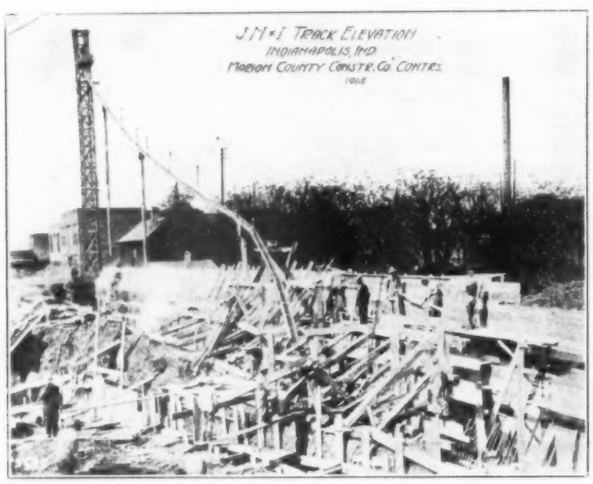
The Proper Use of Concrete Gravity Chutes

By W. H. Insley, Indianapolis, Ind.

The concrete gravity plant has had a very rapid development because of its undoubted economy in the time and labor cost of distributing concrete and its practically universal adaptability to all classes of concrete structures. The straight lift in a tower for the vertical distance between the mouth of the mixer and the top of the forms and then an additional lift of about one foot for every three of horizontal distance between the two before turning the concrete over to gravity to carry it across from the tower to the forms is about as near to nature's absolute foot-pound requirement as can well bedevised.

Like any new process which, because of easily apparent advantages, comes rapidly into general use, its use has out-run the rules of practice which more conservative introduction would have established for it, with the result that every user has made his own rules with little guidance except his own experience and with as variable a product as this procedure might suggest. It is well, therefore, that some thought be given to the statement of some of the fundamental conditions which must obtain to insure a good concrete, which is of absolute importance, as well as to realize the largest ultimate factor of economy in operation, these two ends being obtained by the same means, the one depending on the other, the best concrete being the most economical to handle.

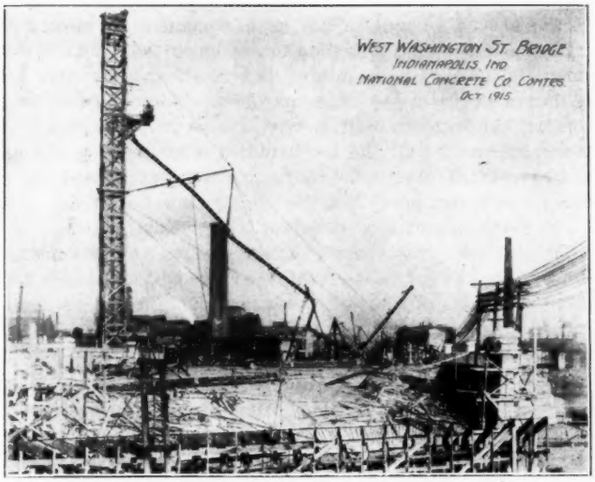
The typical plant consists of a tower with a hoist bucket which takes the batch of concrete from the mixer, a receiving hopper with a controllable gate near the top of the tower into which the batch is dumped from the hoist bucket and a series of chutes or troughs which carry the concrete to the forms. The tower is frequently as high as two hundred feet and the line of chutes may carry the concrete as far as five hundred feet from the tower and by using a relay tower the concrete is placed in the forms at a thousand feet from the mixer. The chutes may be connected in a straight continuous line from the hopper to the forms or this line may be interrupted by line-gates thru which the concrete is dropped a vertical distance thru a closed pipe and then to the forms or by an assembly of horizontal swivel connected chutes it may travel in a more or less zig-zag path, dropping from the end of one chute into the swivel head of the chute below as it proceeds.



The matter of first importance to the successful operation of the gravity plant as well as of any method of distribution is the condition of the concrete when it is discharged from the mixer. Concrete is in proper condition for the gravity plant when it has been subjected to the action of a well designed mixer long enough to thoroughly incorporate all of the aggregates, the batch being assembled with the proper amount of water to hold all of the aggregates in suspension, the resultant mixture being a viscous, homogeneous mass. As to how long the batch should stay in the mixer and as to the amount of water in percentages which this requires, our interest, so far as the chutes are concerned, must be confined to resultants and we must consider these questions as proper subjects for separate discussion. The concrete should not be so dry that it will not level off on top as it stands in the bucket, nor should it be wet enough to show water on top of the bucket if left standing for an appreciable length of time nor to allow a stone to sink much over its own thickness when placed on top of the mass. Too dry concrete limits unnecessarily the range of distribution from a tower of a given height by requiring a steeper chute to carry it.

A wet concrete which allows the heavier aggregates to settle to the bottom will separate in travel and is to be avoided as one of the unpardonable sins. By all means let the concrete be too dry rather than too wet, but there is the right consistency which avoids both extremes. But these problems are problems of mixing, however vitally they may affect the economy of the distributing plant. Properly assembled and well mixed concrete will maintain its integrity by whatever method it may be distributed and concrete which is too wet will allow the stone to settle to the bottom of the form and the mortar will come to the top regardless of the means used to carry it there, while concrete properly assembled, but too hastily mixed will be very much improved by the movement thru a line of chutes as against any other method of transportation. It must be borne in mind, however, that the gravity plant is a plant of distribution and not for mixing and that the concrete must be good concrete, well mixed when it is delivered to the hoist bucket or it can not be expected to be good concrete when the forms are removed.

If the concrete reaches the chutes as a homogeneous mass the slope of the chutes is not of vital importance. That slope is generally the best which will allow the concrete to flow with the least velocity which will insure its passage altho a vertical drop in a closed pipe is a feature of many installations on important work. Such vertical lines, however, should have baffles every few feet to arrest the drop and the concrete should be distributed at the bottom by means of a horizontal chute whenever possible and not directly from the vertical line into the forms. The required minimum slope to carry the concrete properly will vary with the character of the aggregates, the average slope for small round gravel being 1 of rise to 3 of run or an angle of about 18 degrees with the horizontal, the slope for 1-inch stone about 1 to 2¾ or 20 degrees, for 1½-inch stone 1 to 2½-inch or 22 degrees, and for 2-inch stone 1 to 2¼ or 24 degrees with the horizontal. It is better practice on a long line to hang the chutes with a gradually and very slightly increasing grade as they travel toward

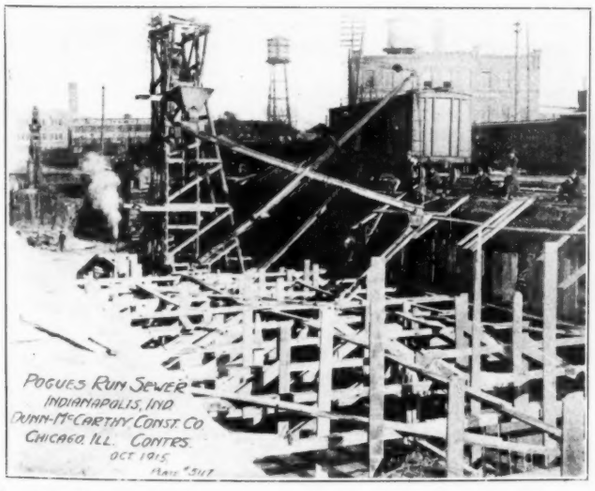


the lower end, such a grading being less likely to cause an overflow in the chutes than the reverse. The final distributing section which places the concrete in the forms should retard the concrete to as slow a movement as will carry it at all.

In the travel thru the chutes the concrete should flow in a constant, uniform stream so far as possible. The man on the tower at the hopper gate is a very important member of the operating crew. An intermittent rush of concrete is apt to congest the chutes causing overflows, shut downs, the retaining of concrete in the tower hopper for an undesirable length of time and damaged work.

The concrete should be placed by the chute as closely as possible at the point where it is to remain. For floors and shallow beams the final chute section should be easily portable with the mouth close to the forms and the concrete traveling as slowly as it can be made to run. For column forms and deep girders the gravity plant provides a closed, flexible drop pipe with frequent baffles or arresters for placing the concrete in the bottom of the form, obviating the objectionable practice of dropping it in the open from the top. If concrete is dropped from the top of a column form in the open or even in a closed pipe without obstruction, the kinetic energy of the stones in the aggregate will drive them toward the bottom of the mass, separating them from the mortar, while if frequent baffles are placed in the vertical pipe the mass will retain its homogeneous character.

To recapitulate, the greatest economy in operation is realized under the conditions which also disclose the best results in the character of the concrete when the forms are removed. The mixing crew must deliver to the bucket properly assembled and thoroly mixed concrete of a viscous, homogeneous consistency. The chutes should be hung at as flat a grade as will readily carry the concrete, this grade varying with variations in the size and character of the aggregates. The concrete should flow thru the chutes in a uniform, constant stream and should be placed by the chutes as close as possible to its final position, avoiding vertical drops without arresting baffles to neutralize the differences in kinetic energy of the aggregates within the mass. These conditions are primary, are easily realized on any work and will insure its success.



Laying Concrete Highway with Bituminous Wearing Surface—Details of Operation and Cost

A six-mile stretch of concrete pavement 15 feet wide and 4½ inches in depth has recently been completed by the California Highway Commission in Santa Barbara county between Santa Maria and Orcutt.

Concrete base was laid on a sandy subsoil, portions of which were very difficult to properly prepare. Numerous methods were adopted such as flooding the sand with water, using different weights of rollers, etc. As soon as the subgrade had been properly rolled, it was necessary to plank the same in order to keep the grade from cutting up.

The total amount of grading in the six-mile stretch was light, involving approximately the removal of 36,000 yards of material. The concrete base consisted of 1:2½:5 mixture placed and tamped in the usual way, with the exception that the surface of the concrete was left in a slightly roughened condition with small corrugations instead of the usual semi-smooth finish.

An asphaltic wearing surface 1½ inches in total thickness after compression was placed upon the finished concrete base, 51,100 square yards comprising the area covered.

Preparatory to laying this surfacing the concrete was thoroly cleaned of all dirt and dust films, 1½ by 2-inch header boards were added to existing 2 by 4 concrete base headers and the surface was treated to a paint binder coat.

The paint binder was composed of one part by volume of 80 to 90 penetration asphalt dissolved in 1½ parts of 50 degree Baumé distillate. The asphalt was heated along the road in a portable kettle and measured quantities in buckets were mixed with distillate at a safe distance from the fire. The paint mixture was then poured on the concrete and swept in an even film over the surface, care being used to obtain an even distribution so that no excess remained in depressions. The sweeping was performed with common house brooms.

As an illustration of the positive binding quality of the paint coat, sections cut out from the finished pavement were so thoroly bound that in tearing apart the two surfaces, portions of the broken concrete adhered to the Topeka surface.

The cost of cleaning concrete base and applying paint coat was as follows:

MATERIALS.		
8 tons asphalt @ $8.75 per ton	$ 70.00	
3745 gals. distillate @ 5c per gallon	187.25	
2 cords wood @ $6.00 per cord	12.00	
Tools, etc., plant	6.50	
Total		$ 275.75
LABOR.		
Total labor including 2-horse broom	$650.55	
Pro rated superintendent, timekeeper, etc.	52.50	
Bonds and insurance	54.90	
4 per cent contractor's overhead	28.12	
Total		$ 786.07
Total of both items		$1061.82

Unit cost—$0.0207 per square yard.

The Topeka asphaltic wearing surface is too well known to require any discussion here. However, it may be of interest to compare the actual results obtained in the field when checked against laboratory tests made at the state laboratory at Sacramento as shown in the accompanying table.

The hot mixture was turned out by a large portable Cummer plant having a capacity of approximately 300 to 1,000-pound batches per 8-hour day. Views of the plant are shown herewith.

The main plant is mounted on one set of railroad trucks 66 feet over all. An auxiliary flat car accompanied the main plant, loaded with accessories. In the order named the machinery was mounted on the main truck as follows: Boiler, open elevator, revolving drum (dryer), hot sand elevator, hopper, mixing box, weighing kettle, tank and agitator. This order is from right to left in the front view and from left to right in the rear view of the plant.

A 60-horse power engine and 80-horse power boiler mounted on skids and installed on the ground near by at the open elevator end of the trucks operated the different units.

On the opposite side of the mixing box the operator weighs out the proper amount of hot asphalt cement by means of a kettle suspended on a traveling beam scale. This hot asphaltic cement is placed in the mixing box in the regular way after the hot aggregate and cold marble dust have been thoroly mixed. About 1½ minutes were required for a thoro and proper mixture of all the ingredients. This mixing was done by two sets of blades revolving in opposite directions, the blades being staggered and the shafts so set that the blades on one shaft just cleared those on the opposite shaft.

The asphaltic cement was agitated in a two-compartment tank of about twenty barrels capacity each. Pressure is maintained by means of a small compressor installed in one end of tank to force the liquid asphalt thru a pipe and valve near the mixing box.

The mixing box was equipped with a horizontal sliding gate operated by steam valves controlled by a lever on the operator's platform. The finished batch was discharged thru this gate to the truck or wagon waiting below.

In preparing surface "hot stuff" at the mixing plant, the

TABLE OF CERTAIN ANALYSES OF "TOPEKA" MIX ASPHALTIC SURFACING SHOWING SACRAMENTO LABORATORY TEST AND FIELD TEST OF THE SAME DAY.

Date, 1915.		Apr. 26.		May 3.		May 6.		May 7.		May 15.		May 19.		May 20.	
Passing	Spec. betw.	A	B	A	B	A	B	A	B	A	B	A	B	A	B
200-mesh.....	8% and 13%	9.1	9.0	13.2	13.4	10.4	11.8	10.2	13.7	9.4	10.8	8.4	8.4	9.9	10.1
80—200.....	14% and 25%	19.6	19.0	23.8	19.7	20.1	19.0	21.5	20.0	16.9	19.5	23.0	21.8	18.0	21.9
40—80.....	17% and 29%	24.1	21.0	27.4	27.0	26.6	25.0	28.3	27.0	27.3	26.7	25.8	26.5	27.4	24.2
10—40.....	5% and 11%	11.5	10.5	10.1	10.3	10.8	11.8	11.2	11.5	13.3	11.8	10.8	11.3	12.3	11.7
4—10.....	15% and 25%	18.0	22.0	10.6	14.0	15.3	16.0	12.0	11.9	14.9	14.4	17.0	16.2	18.5	16.2
2—4.....	3% and 10%	9.2	9.0	5.3	6.0	7.0	6.7	6.8	6.4	8.8	7.2	6.4	6.2	4.2	6.3
Bitumen.....	7½% and 10%	8.5	*9.5	9.6	*9.6	9.8	*9.7	10.0	*9.5	9.4	*9.6	8.6	*9.6	9.7	*9.6

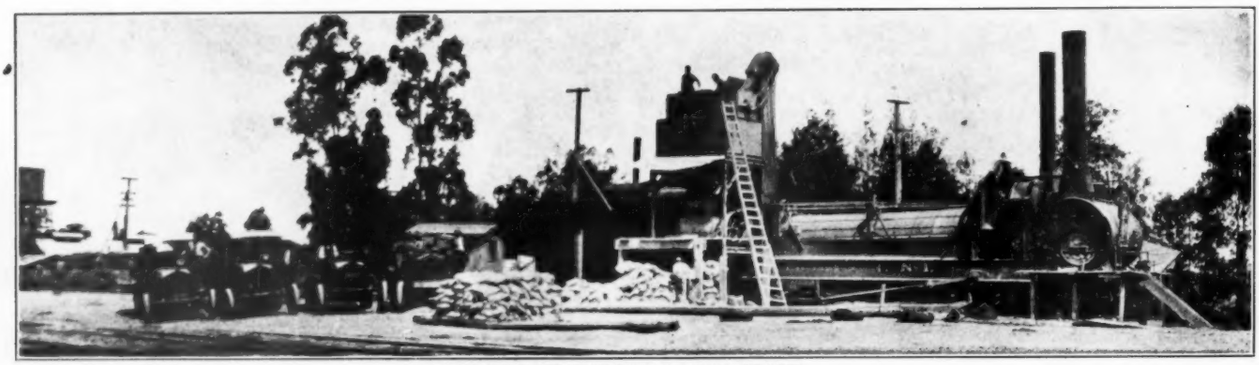
Note: A—Sacramento laboratory test; B—field test; * represents per cent. of bitumen calculated.

Under the revolving drum a battery of oil burners was arranged, the flames being so regulated as to keep the temperature of the dry mix at approximately 325 degrees Fahrenheit.

In order to check the temperature of the dry mix, test samples were taken from a trap door in the bottom of the hot elevator near the discharge end of the dryer.

The hot aggregates were elevated about 30 feet thru a closed chute and dumped into a closed hopper of about one cubic yard capacity. This hopper had a bottom discharge consisting of a sliding gate controlled by a lever on the mixing platform. The gate opens into a box nine cubic feet in capacity, which in turn empties thru a similar gate controlled in the same manner, into the mixing box.

The carbonate of lime or dust filler was measured separately on a small wooden platform adjacent to the mixing box and placed by hand. This method is not very satisfactory. asphaltic cement and stone dust were weighed separately into each batch, the sand and broken stone screenings were brought in piles to wagons and the proper proportions of each carried to position adjacent to bucket elevator by a fresno scraper and spread in layers. By cutting across the layers with their shovels, two laborers feeding the bucket elevator were so controlled that the mixing ensuing came well within the desired specifications. The plant inspector checked the mixture by taking samples from time to time during the day from the mixer box—such samples containing everything excepting the asphaltic cement and being thoroly mixed. A 2-pound sample was run thru the sieves, and, owing to the size of sample, operative errors were reduced to a minimum. As an interesting corollary, these tests checked with Sacramento laboratory analyses of finished pavement to a degree of exactness rarely encountered.



FRONT VIEW OF CUMMER MIXING PLANT.

The materials entering into the mixture were obtained as follows:

1 Sand—Santa Maria river.
  (a) A fine blow (surface) sand.
  (b) A medium fine sand (12 to 18 in. below surface).
2 Broken stone screenings—Daugherty quarry—S. L. O.
  (a) Passing ½ in., retained on ¼ in.
  (b) Passing ¼ in., retained on 10-mesh.
3 Pulverized limestone—Western Rock Products Company, San Francisco, Cal.
4 Asphaltic cement—California Liquid Asphalt Company, Hadley, Cal.

The materials hauled to the plant cost as follows:

Sand, per ton	$0.75
Screenings, per ton	1.60
Limestone (dust), per ton	6.10
Asphaltic cement, per ton	8.75

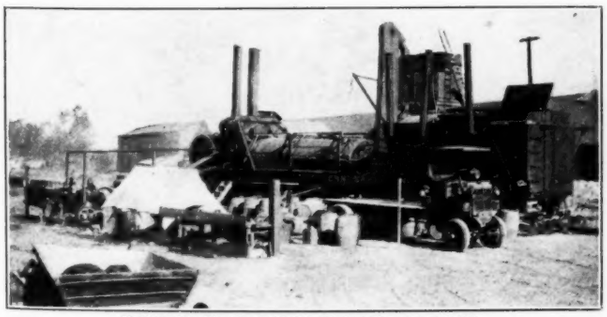
The mixing process at the plant was carried thru so that the complete cycle of each batch averaged 1¾ minutes, which limited the capacity of the plant to 280 batches, weighing approximately 1,000 pounds each, or 140 tons of "hot stuff" per 8-hour day. A complete cost of plant operation, batch and ton costs of mixture, etc., is appended to this report.

Some little difficulty was experienced in deciding upon the proper amount of asphaltic cement to add to the mixture during the first period of the work. In order to obtain proper "pat stains" and to keep a firm pavement under the rolling, the amount of asphaltic cement per 1,000-pound batch was increased from 92 pounds to 98 pounds, and subsequently decreased to 96, at which point the greater portion of mixture was turned out. Based on "pat stains," 97 to 98 pounds of asphaltic cement per 1,000-pound batch seemed to be the proper amount, but excessive "balling up" occurred in the raking and the surfacing "jellied" under the roller, so this amount was cut back to 96 pounds.

The plant operation was carried on with the following labor:

General superintendent	½	day @	$7.50	$3.75
Foreman	1	day @	5.00	5.00
Engineer	1	day @	5.00	5.00
Watchman	1	day @	3.00	3.00
Mixerman	1	day @	3.00	3.00
Asphalt man	1	day @	2.75	2.75
Laborer	1	day @	2.75	2.75
Laborer	2	dys. @	2.50	5.00
2-h. Fresno, team and driver	1	day @	5.00	5.00
Total				$35.25

The mixture was hauled to place on the pavement in three 5-ton motor trucks with end dump bodies, each truck load consisting of 13 batches or approximately 6½ tons. The contractor paid for this hauling at the rate of 30c per batch. The average haul was three miles. The haul therefore cost 20c per ton mile. The hauling contractor paid his drivers full time on this work, and kept four trucks on hand (one for emergency), and, owing to the delays due to wet weather (12 days out of 36), his profit was a very meager one.



REAR VIEW OF CUMMER MIXING PLANT.

A typical paving gang on this work consisted of thirteen men, as follows:

General superintendent	½	day @	$7.50	$3.75
Foreman	1	day @	6.00	6.00
Rollerman	1	day @	5.00	5.00
Raker	1	day @	3.50	3.50
Raker	2	days @	3.00	6.00
Tamper	1	day @	2.75	2.75
Shovelers	5	days @	2.50	12.50
Hand rollerman	2	days @	2.50	5.00
Total				$44.50

An average day's work for this gang is 2,000 sq. yds. of 1½-inch surfacing. The above amount of $44.50 does not represent the total cost of laying, as certain lost time charges, general superintendence and contractor's overhead and some incidental supplies and plant charges must be added. Complete laying costs appear in cost data supplementary hereto.

Cost Data.

PLANT OPERATION.

Setting up plant	$241.70
Wrecking plant	68.25
Labor at plant (mixing)	914.00
Labor at plant (watchman)	119.75
Blacksmith work	14.50
Superintendent, timekeeper, horse and buggy (one-half total cost)	210.00
Water	40.00
Oils and fire brick, etc.	29.82
Hardware, etc., belting	50.00
Wood for fuel	100.00
Gas for fuel	290.50
Rental at $50 per day	1,500.00
Freight on plant (and return)	870.00
Incidentals—R. R. fare, etc.	35.00
Bonds and liability insurance	219.60
Phone, etc.	37.50
Freight on wagons and tools and depreciation on same	300.00
	$5,040.62
Plus 4 per cent	102.73
	$5,143.35

LAYING SURFACING.

Labor	$1,247.15
Rolling	205.00
Transporting men, etc.	250.00
Headers (labor)	103.70
Superintendent, timekeeper, etc.	157.50
Insurance and bonds	164.70
Railroad fare (incidentals)	35.00
Phone, etc.	37.50
Freight on equipment and tools, and interest and depreciation on same	200.00
Supplies for roller	13.00
5.86 tons coal for roller	88.00
Hardware, etc.	43.50
Lumber for headers	504.70
	$3,049.75
Plus 4 per cent	78.53
	$3,128.28

PAINT COAT.

Total	$1,061.82
Incidental work—shoulders, etc.	$522.15

MATERIALS.

Hauling sand and other materials	$1,656.50
Unloading stone dust	28.45
Screening rock (dirty)	89.65
1,083.13 tons rock (screenings)	1,158.97
286 tons extra sand	128.70
344.05 tons asphaltic cement at $8.75	3,010.45
210 tons limestone dust at $6.10	1,281.09
	$7,353.72

Hauling "hot stuff" by contract:
30c per batch, 7,580 batches $2,274.00
(40 batches rejected on job; 7,540 batches net in pavement.)

SUMMARY.

	Total.	Per Sq. Yd.	Per Ton.	Materials and Mixing Per Ton.
Clean concrete and paint coat..	$1,061.82	$0.0207	$0.282	
Laying surfacing	3,128.28	0.0612	0.830	
Plant operation	5,143.35	0.1005	1.364	$1.364
Incidental work on shoulders..	522.15	0.0102	0.138	
Materials for mixture	7,353.72	0.1440	1.951	1.951
*Hauling mixture	2,274.00	0.0445	0.604	
Totals	$19,483.32	$0.3811	$5.169	$3.315

*Note.—40 batches, or 20 tons, of mixture were thrown out on the work, leaving 7,540 batches to go into the pavement.

From May 9 to 27, 1915, inclusive, motor trucks hauling hot mixture traveled over the 2½ miles of completed pavement. Each truck, full, weighed approximately 24,000 pounds; empty, 11,000 pounds. The average daily tonnage due to this traffic alone was 282 tons, and the concentration of load (12 tons on loaded trucks) was extreme. During this period the minimum temperature (atmospheric) was 48 deg. F. and the maximum 97 deg. F. A careful examination of the finished surfacing disclosed no signs whatsoever of faulty spots, rolls or fine cracks on May 28.

With the opening of the complete road the expected heavy traffic has resumed travel on this route and later in the year some tonnage records of interest will be available.

The above data were furnished thru the courtesy of Austin B. Fletcher, State Highway Engineer of California, and were taken from the report of Walter C. Howe, Division Engineer.

New Chicago Bridge Design

The city of Chicago has accepted the design for new bridges proposed by the Illinois chapter of the American Institute of Architects.

At a meeting in the office of William Morehouse, commissioner of public works, it was decided to use the design for the bridges at Madison, Franklin, Clark and La Salle streets, work on which will commence soon. Those who conferred with Mr. Morehouse were Thomas Pihlfeldt, engineer of bridges for the city, and the following members of the municipal art committee of the American Institute of Architects: George W. Maher, chairman; E. C. Jensen, Hubert Burnham, Earl H. Reed, Jr., L. E. Stanhope, H. F. Stevens, and Mr. J. Schiavoni.

At the approaches to the bridges will be bronze groups of statuary. About twenty-five feet nearer the bridge will be heroic pylons, severely plain, but ornamented on the top with the Chicago seal. Granite balustrades will connect the pedestals on which the statuary is to stand with the pylons.

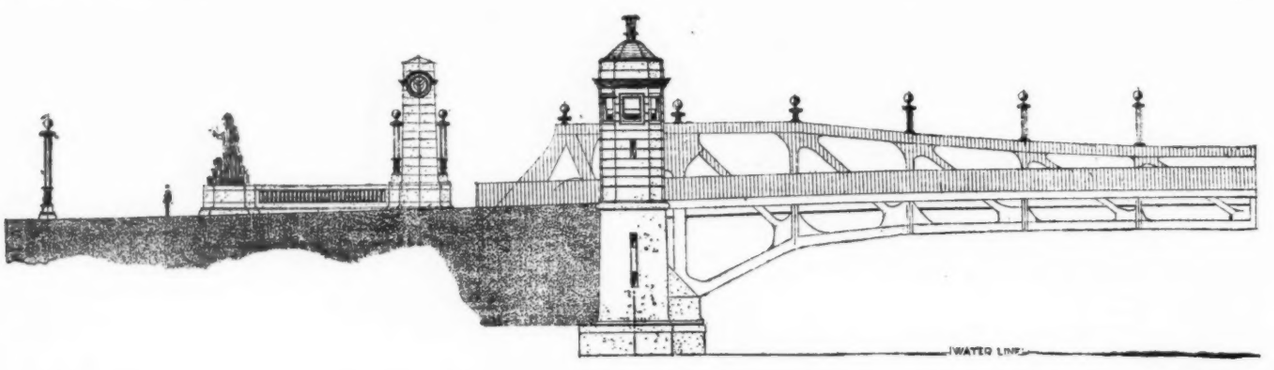
The tower houses are to be built of terra cotta of a granite texture. In the past these have been built of wood, galvanized iron, and concrete. The pylons will be 26 feet high.

Good Roads Notes

Kansas will organize its prisoners for road work and will shorten each sentence one day for every three that the man works faithfully and cheerfully on the public roads. Municipalities can have the labor by paying $1 for each day's labor for each man employed. About half of this sum will be used in feeding and caring for the man and the remainder will be paid to him or to his family.

While the Shackleford good roads bill has passed the United States House of Representatives by a vote of 281 to 81 the prospects of the bill do not seem so promising in the Senate. Several senators have bills of their own which differ more or less from the one which has run the gauntlet of the House and have strength which must be reckoned with. Too many of the bills have the odor of the pork barrel which has been a piece of congressional furniture for so long and no law will be preferable to laws of the nature of some of them. The preparedness program should by all means include highway improvement, for good roads are an absolute essential to prompt and rapid movements and good roads can not be built in a day, while automobiles and horses can always be obtained on the shortest possible notice.

The Shackleford bill, which has passed the House, would appropriate $25,000,000 to aid the states in improving post roads of importance, outside of cities or towns of 2,000 population or more. Each state would receive $65,000 plus its share of half the remainder in proportion to population and of the other half in proportion to mileage of rural free delivery routes in operation, from 30 to 50 per cent. of the total reasonable cost of the construction of maintenance of an approved road being paid from the funds. The shares of the states are computed to range from $101,102 in Nevada to $1,594,412 in New York, Illinois, Ohio, Pennsylvania and Texas are the only other states which would receive more than $1,000,000 each.

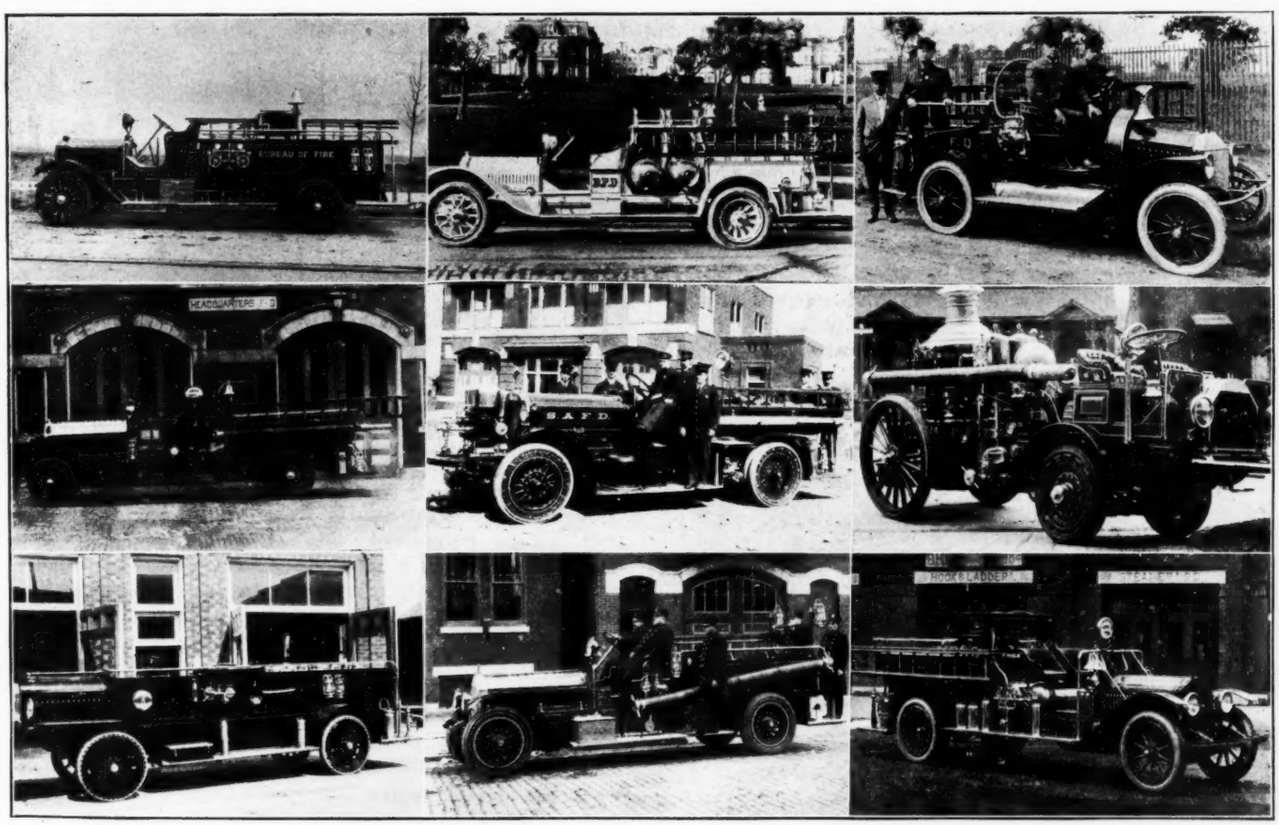


FIRE DEPARTMENT

New Developments in Fire Apparatus

A recent demonstration of electrically driven fire apparatus was held on the steep grades in and around Paterson, N. J., during November at the time of its initial installation in that city. The tests showed the remarkable power of a combination chemical engine and hose wagon fully equipped with twenty lengths of hose and a crew of fourteen men, weighing in all 18,320 pounds, and a second piece of apparatus, consisting of a 65-foot aerial ladder, carrying a crew of twenty-two men, with total weight of 20,000 pounds.

These two pieces negotiated an 18.23 per cent. grade, over an uneven cobblestone paving, in 1 minute 13 seconds, starting at the foot of the hill from a dead stop. This hill always had been used as a test hill for every piece of apparatus used by the Paterson fire department, and the previous fastest time had been 1 minute 40 seconds. It is interesting that these pieces of electrically driven apparatus made the run from Philadelphia to Paterson, approximating 125 miles, in fourteen hours, elapsed time, including stops at Trenton, New Brunswick and Newark.



BOYD COMBINATION CHEMICAL AND HOSE, PHILADELPHIA, PA.

SOUTH BEND TRIPLE COMBINATION, INDEPENDENCE, KANS.

DUPLEX COMBINATION FOUR WHEEL DRIVE, CHARLOTTE, MICH.

WHITE COMBINATION CHEMICAL AND HOSE, BAKERSFIELD, CAL.

AHRENS-FOX PUMPER EQUIPPED WITH SEWELL CUSHION WHEELS, SAN ANTONIO, TEX.

BOYD COMBINATION CHEMICAL AND HOSE, CAMDEN, N. J.

CENTRAL WAGON COMBINATION SEAGRAVE TWO-WHEEL TRACTOR FOR STEAM ENGINE.

SEWELL CUSHION WHEELS, INDIANAPOLIS, IND.

WHITE COMBINATION CHEMICAL AND HOSE, BEVERLY, MASS.

FIRE APPARATUS STATISTICS.

In 315 cities with population of over 10,000 each, there were, in 1913, 7,059 pieces of horse-drawn fire-fighting equipment. In 500 cities of the same class there were, in 1914, 5,897 pieces of horse apparatus, or with 60 per cent. increase of listed cities a decrease of 1,162 pieces of horse apparatus. In these 500 cities motor apparatus included 211 pumping engines, 148 triple combination pump, chemical and hose cars, 700 combination chemical and hose wagons, 201 ladder trucks, 269 pieces of apparatus drawn by tractors, and 724 cars of all classes; a total of about 2,300 pieces of motor fire apparatus. In 1916 appropriations for the purchase of $15,000,000 worth of motor fire apparatus have already been made by American cities, and yet only 50 per cent. of the cities in the United States maintaining fire departments have a single piece of motor-drawn apparatus.

HAVE THIRTY MOTOR PIECES.

The city of Boston, Mass., has thirty pieces of motor apparatus in its fire department. All of the chiefs are supplied and a long stride has been taken in motorization, according to the plans laid down several years ago, and which have been indorsed by the present administration. The mayor believes that motorization is one of the most important lines of progress that the city should pursue, but owing to lack of funds he has been obliged to curtail plans for the year. All the tractors that have been delivered to the department within the past year, the gas pumping engine and several chemical wagons have given the greatest satisfaction. Certain sections of the city that have never been adequately protected are now held to be much safer with the installation of motor apparatus, especially in the districts of heavy grade, such as Orient Heights and the Parker Hill section of Roxbury.

DUPLEX FOUR WHEEL DRIVE.

In this issue we illustrate an approved type of duplex apparatus possessing traction upon all four wheels. Together with its broad range of eight speeds, it is possible to get an extremely low reduction as well as extremely high gear. With the eight-speed feature, the truck has a range of speed from 1 mile per hour to 50 miles per hour with the motor running at its maximum efficiency. This allows it to make the side streets thru mud, sand, snow and up the heavy grades.

The following statement shows the upkeep and running expense of the Charlotte (Mich.) duplex motor fire truck from September 20 to November 22:

Sept. 20—First test, traveled 11 miles, consumed 7½ gallons of gasoline	$0.75
Sept. 23—Demonstration for drivers, 3.6 miles, consumed 1.5 gallons of gasoline	.15
Sept. 30—Two trips to fair grounds for exhibition purpurposes, gasoline consumed, 5 gallons	.50
Oct. 4—Demonstration for drivers, 4 gallons of gasoline consumed	.40
Oct. 19—Exhibition (Wolverine Paved-way) 7 gallons of gasoline consumed	.70
Oct. 22—Fire call, Hildreth's barn, 4 gallons of gasoline	.40
Oct. 28—Exhibition before Grand Rapids business men, 2 gallons gasoline consumed	.20
Nov. 4—Fire drill, 3 gallons of gasoline consumed	.36
Nov. 6—Fire call, on West Lawrence avenue, 3 gallons	.36
Nov. 7—Fan belt	.40
Nov. 10—Fire drill, gasoline consumed, 2.5 gallons	.30
Nov. 12—Fire call, Solomon's barn (gasoline not measured).	
Nov. 18—Fire call, gasoline consumed, 3 gallons	.45
Nov. 22—Fire call, gasoline consumed, 7 gallons	.95
Total cost	$6.02

The foregoing statement covers a period of 66 days, or until the week ending November 27, which shows a cost of 9.8 cents per day up-keep.

The truck is equipped with Westinghouse starting and lighting system, with two electric headlights, one red tail light and an extra powerful searchlight mounted on the dash and swinging on a swivel so that it can be turned in any direction and the Bosch dual ignition system. The transmission is the selective sliding gear type, with eight speeds forward and two reverse, ranging from a ratio of 5¼ to 1 on high to 64 to 1 on low.

The fire-fighting equipment consists of one 40-gallon chemical tank, nickel plated, with the latest improved agitator for mixing the chemicals and a steel basket containing 150 feet of best rubber chemical hose; one 30-foot trussed extension ladder, one 15-foot trussed hook ladder, two pike poles, one heavy door-opener, one crow bar, two axes, two lanterns, two hand chemical tanks, large gong, extra charge of chemicals for the big tank and stakes for hose pipes. The steel hose box has a capacity for 1,500 feet of standard fire hose. Underneath the rear and opening onto the back step is a large box for helmets and other accessories. The upholstering is of a genuine handbuffed leather. A draw bar thru the frame in the rear permits a trailer to be attached in emergencies. The tires are Goodyear cellular cushion, solid rubber, made especially for motor fire trucks. The approximate weight without the hose load is 6,800 pounds.

ALAMEDA'S COMBINATION FIRE TRUCK.

Alameda, Cal., has adapted a Packard 2-ton chainless chassis to fire department service. The special body carries combination water and chemical apparatus, including two chemical tanks and ¾-inch hose, several reels of 3-inch water hose, extinguishers, extension ladders, axes, door-openers, etc. A speed of 30 miles per hour is easily attainable by leaving off the standard motor governor.

Growth of the Automobile Industry

Some results of the U. S. census of the automobile industry for 1914 are available, together with comparisons with the census of 1909. In the five years there was an increase of 350.3 per cent. in the number of automobiles made and of 181.7 per cent. in the total value. The decrease in unit cost which these figures indicate was due in part to a general reduction in prices, but mainly to the greater increase in number of the low-priced cars, which itself would considerably reduce the average cost.

The total number of gasoline and steam automobiles made in 1914 was 568,399 and of electrics 4,715.

The increase in number of gasoline and steam machines over 1909 was 360.4 per cent. and in number of electrics was 22.9 per cent. The increase in number of delivery wagons was much greater than the average of all automobiles, the increase being from 2,771 in 1909 to 22,753 in 1914, or 721.1 per cent.

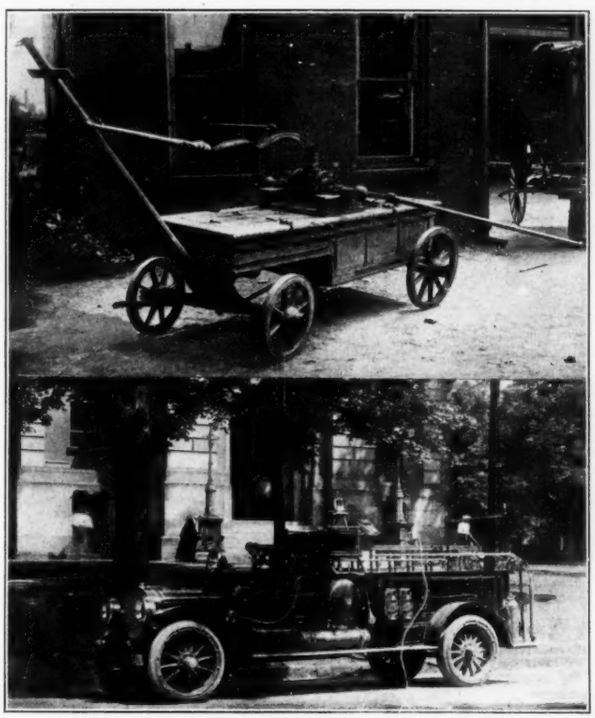
The popular car had from 20 to 29-h.p. in 1914, the number of such cars being 346,399. The 30 to 49-h.p. cars were next, with 163,468, and others were much less, down to 391, with less than 10-h.p.

Test of Steam and Electric Plant in New York Hall of Records

Quite a controversy has arisen over the issue of a report on a recent test of the steam and electric plant in the New Yory City Hall of Records. The Bureau of Municipal Research, an independent organization, the boro of Manhattan and the New York Edison Co., were represented in the test and the latter has made publication in advance of the issue of the official report, to the effect that the plant in the building can be operated more cheaply with current supplied by that company than by operating the building's own plant. The Bureau of Municipal Research states that its counsel advises it that the rate of electricity must be materially reduced before this statement can be true and that some changes in the local plant will materially improve its efficiency. Under present conditions and the present public service rate of 3 cents per kw.-hr. for electric current the loss per year to the city by using Edison Company's current would be $9,400, and a reduction to $1.66 cents per kw.-hr. in the charge for current would be required to offset this difference.

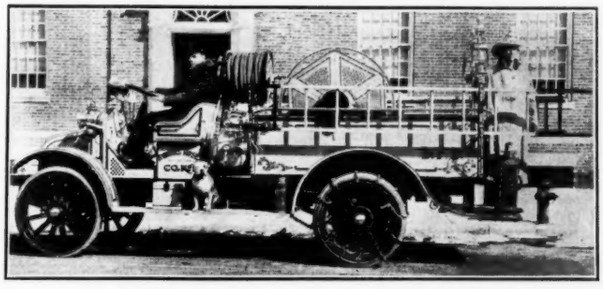
Fire Department Notes

William Guerin started in the New York fire department as a fireman in 1889, when Hugh Bonner was chief. He worked his way up the ladder, earning promotion through the successive grades of engineer, lieutenant, captain and deputy chief. He missed by a fraction of 1 per cent. appointment as head of the department, but he has done a greater work in establishing the City Fire Prevention Bureau. From 1911 to 1913, when he retired, the fire loss of New York City was reduced by many millions of dollars a year as a result of reforms instituted by Chief Guerin. It showed what could be done. At once the idea spread over the country. Portland, Ore., was one of the most successful cities in establishing bureaus of this kind. Factories were cleaned up, fire alarm systems overhauled, extinguishers installed and means of egress cleared or enlarged. A striking example of Chief Guerin's knowledge of fire hazards was shown early in December, when Hopewell, Va., was wiped off the map because it neglected to take the precautions that he advised. In August Chief Guerin was called into consultation by the Business Men's Association of Hopewell. He made an inspection of the "magic city" and then entered his report, urging that inasmuch as there was no water supply, the city be equipped with small one-quart fire extinguishers. "A daily miracle is performed when the sun rises and finds your city intact," he wrote, and he added: "What you have to fear most is fire, for if it once got any great headway, your city's name would be Hopeless." His warning was ignored and the city was swept away. He has been chosen as head of the new engineering bureau recently established by the Pyrene Manufacturing Company.

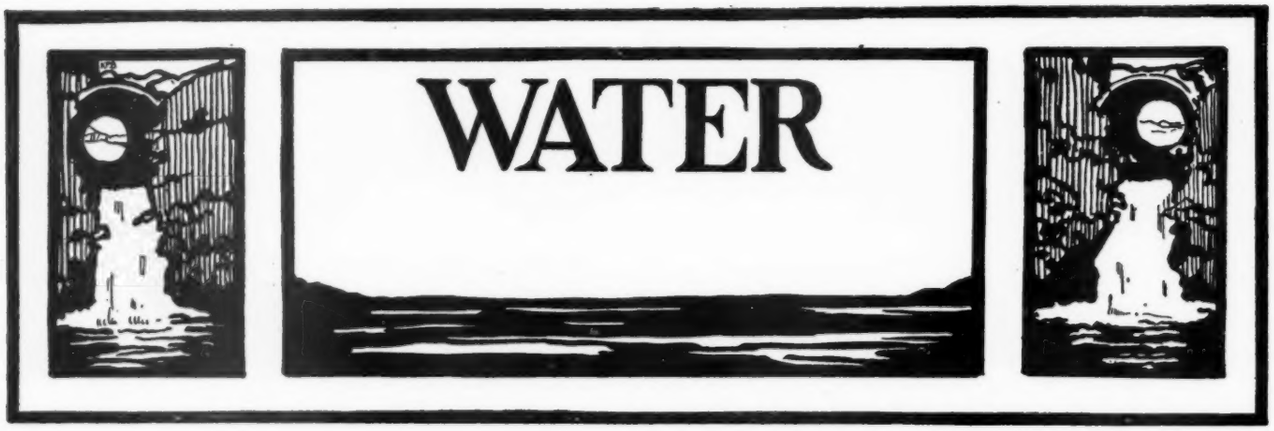


The volunteer fire department of Beaver, Pa., D. A. Moore, chief, has a Boyd chemical and hose motor truck, a horse-drawn ladder truck and a hand-drawn hose reel. Municipal water works pressure is 100 to 105 pounds. The two photographs accompanying show the latest piece of fire apparatus and what may have been the earliest in Beaver. At any rate, the old hand pump and cistern on the low wagon wheels is older than any one now living can remember.

The accompanying photograph was sent us by W. C. Jamison, chief of the fire department of Dover, Del., who is standing on the rear of the motor-driven chemical and hose combination shown. The chassis is a Kelly 4-cylinder machine equipped by the United States Fire Apparatus Co., of Wilmington, Del., from plans drawn by the Robbins Hose Co., No. 1, who operate the machine. The equipment consists of a 35-gal. chemical tank with 200 ft. of ¾-in. hose; 1000 ft. of 2½-in. hose on the reel in the center; a 10-ft. roof ladder; a 20-ft. extension lad-



der; an acid holder, two 3-gal. hand extinguishers, 2 nozzles, ax, bar, 2 lockers in rear of body for tools and equipment for eight men, four of whom use the covers of the lockers for seats. It is a 1-ton truck, but readily and often carries 1½ tons. Chief Jamison enjoys looking over the machines shown by other chief engineers and reciprocates by sending a description of their product. The background shows a little of the detail of the architecture of the Delaware state capitol.



Pumping Station Profits By Substitution of Electric Power for Steam

By John A. Randolph
The Society for Electrical Development, Inc.

At the Springdale pumping station, which furnishes the entire water supply for the town of Canton, Mass., the power for a new equipment of electric pumps supplanting a former steam installation has cost less during the past year than the coal used for the formerly used steam pumps, and a large saving has been effected in labor.

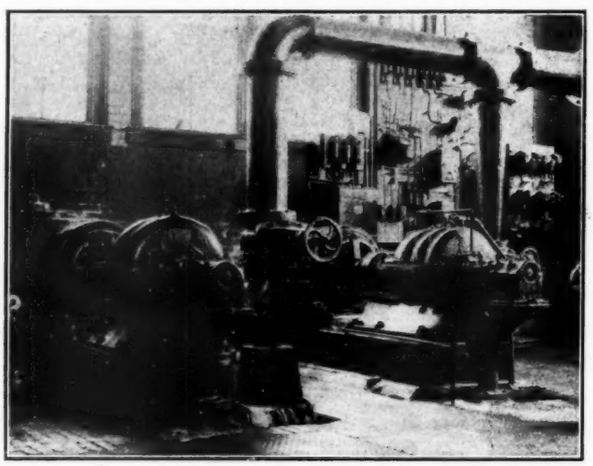
The steam equipment had been in service for 24 years. It comprised two horizontal boilers and two large compound duplex steam pumps of 700 gallons per minute capacity, with condenser and boiler feed pumps.

The new electric equipment is made up of one 400-gallon-per-minute DeLaval 3-stage centrifugal pump direct-connected to a 25-h. p. motor, running at 1,750r. p. m., and one 700-gallon 2-stage pump direct-connected to a 75-h. p. motor. The latter pump is reserved for fire use only.

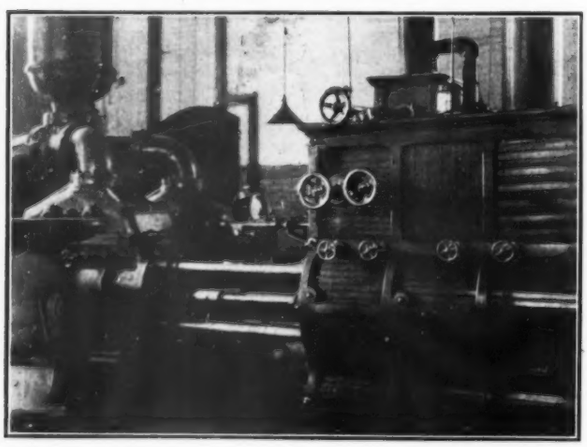
Since the installation of the electrical pumps, the income from metered water has been increased from $12,826 to $14,432. This is due to the higher water lever maintained in the standpipe by the long slow pumping day and night.

The electrical outfits have an advantage over the former steam equipment in that they are much smaller and more compact. The two electrics were installed in the space formerly occupied by one of the steam pumps. The centrifugal pumps are simpler in construction owing to the absence of a multiplicity of valves, pistons, reciprocating parts and packing boxes. They are thoroly reliable and are readily adaptable to automatic control. The station and premises can be kept much cleaner with electric power than with the use of steam.

For starting and stopping the electrical pumps a Cutler-Hammer starter designed for remote control is used. This device has been connected to several pieces of control apparatus placed at various points for the purpose of automatically starting or stopping the pump as required. One connection is made to a float switch in the well, which actuates the relay of the starter when the well is empty thereby stopping the pump and preventing the uncovering of the check valve.



ELECTRIC PUMPS *in space formerly occupied by one engine.*



ONE OF THE TWO *steam pumps used in the Canton, Mass., station previous to electrical installation.*

Another connection is made to a pressure gage, which starts the pump when the water level in the standpipe has dropped to a certain point.

A time clock is also connected to the starter for the purpose of starting and stopping the pump three times each day on a regular schedule—morning, afternoon and midnight.

The total amount of water pumped last year was 106,000,000 gallons against an average working head of 190 feet or 82 pounds. The electrical energy required for this work was 120,000 kw.-hr. purchased at an average rate of 2 cents per kw.-hr. The coal used during the previous year with steam operation when 10 per cent. less water was pumped amounted to 442 tons, costing $6 per ton.

The electric power for this installation is furnished by the Edison Electric Illuminating Company of Boston.

Efficiency Budget of Chicago

The first efficiency budget in the recent history of the city of Chicago has been transmitted to council. The result is an appropriation bill providing for reorganization of city departments that will effect an outright saving of $600,000 annually.

The total amount estimated as necessary to run the city departments for the year is $26,885,993, a figure nearly $2,000,000 below the estimate submitted by former Controller Traeger last year. It is a little in excess of the revised 1915 appropriation bill as passed by the city council.

It has been shown that if the proposed efficiency program is carried out the savings will amount to $610,882. This program calls for the following changes:

	Saving.
Consolidation and elimination of duplication in the inspection service as recommended by the efficiency division and approved by the controller	$405,582
Standardization of service and compensation in law dept. as recommended by the efficiency division	75,300
Consolidation of municip'l construct'n and repair shops	50,000
Consolidation of all municipal testing laboratories	20,000
Consolidation of all municipal storehouses and unification of delivery systems	10,000
Further estimated reduction in election expense	50,000
Total	$610,882

SUMMARY OF DEPARTMENT ESTIMATES AS GIVEN IN THE 1916 BUDGET:

Department No.		Controller's estimate. 1916.	Revised appropriation. 1915.	Expenditures year ended June 30, 1915.
9	Streets and alleys	$500.00	$450.00	$85.31
10	Harbors, wharves, bridges	500.00	500.00	502.29
11	Plan commission	.....	29,650.00	18,214.22
12	Committee on health	500.00	900.00	954.90
13	Railway terminals committee	.....	37,350.00	36,211.65
25	Board of election commissioners	1,345,045.00	724,607.00	829,701.97
26	Civil service commission	67,510.00	103,835.00	96,180.58
27	Department of supplies	34,666.38	32,545.12	29,923.61
30	Department of police	7,381,347.65	7,320,623.32	7,160,733.46
32	House of correction	360,226.02	374,767.02	364,349.36
34	Commission on gas litigation	100,000.00	.....	.....
35	Department of fire	3,544,880.40	3,544,385.92	3,523,043.28
36	Department of buildings	182,025.00	180,456.81	177,907.01
37	Department of health	1,313,097.20	1,507,444.09	1,523,436.60
40	Inspection of steam boilers, steam and cooling plants	48,498.52	53,125.12	50,436.90
41	Weights and measures	38,920.00	40,440.00	38,535.28
42	Smoke inspection	33,458.15	41,050.00	39,738.25
44	Hospitals	20,000.00	20,000.00	.....
45	Office of inspector of oils	15,960.00	16,420.00	15,980.37
46	Department of public welfare	43,385.00	49,360.00	44,749.17
50	Board of local improvements	786,366.37	995,997.56	906,248.22
52	City markets	1,990.00	1,990.00	.....
60	Special park commission	231,365.00	251,418.33	368,742.22
80	Department of electricity	2,922,863.02	2,522,135.27	2,475,571.45
90	Department of public service	94,313.95	119,662.56	129,960.48
101	Office commissioner public works	49,855.00	86,170.00	51,972.88
102	Bureau of compensation	7,645.00	8,010.00	7,313.63
103	Bureau of maps and plats	45,026.00	47,406.00	42,931.28
104	Bureau of architecture	73,784.08	84,659.08	29,012.56
105	Bureau of city hall	268,436.60	248,299.20	240,100.38
200	Bureau of streets	3,566,557.00	3,840,373.75	3,627,499.86
300	Bureau of sewers	519,423.00	485,915.80	499,175.06
400	Bureau bridges and viaducts	532,180.00	468,823.89	400,160.20
450	Bureau of rivers and harbors	323,375.45	309,025.75	272,452.27
	Totals	$27,496,885.26	$26,623,588.11	$26,195,573.79

Useful Knowledge for Well Drillers

By M. C. Potter.

In drilling wells it is not unusual for the bit to become jammed. Getting it loose is no easy task as every well driller knows.

Recently I was called in to assist in loosening a jammed bit in a well that was down to a depth of 170 feet. I had never tried anything of the sort before, so I had to proceed very cautiously to avoid damaging the bore hole.

I knew that dynamite wouldn't explode under certain water pressure; also that I must be very careful about waterproofing my charge, so I decided to try a half cartridge of 60 per cent. gelatin, made water-proof by inserting it in a small rubber sack. It was primed with a water-proof electric blasting cap and fired with a blasting machine.

I got the charge down close to the bit by weighting it so that it would sink and pull the leading wire down with it. It is necessary to have the wire free from kinks so that it will run smoothly.

This little shot released the bit without much damage to the bore hole.

I have since found that it is sometimes necessary to make three or four such shots to release a bit. The cost of the work will average about $5, which is money well spent because of the time it saves the well drillers.

MISCELLANEOUS

The March of Events

March 6-10, Sohmer Park, Montreal, Que. Canadian Good Roads Congress and Dominion Good Roads Association. Geo. A. McNamee, secretary, 909 New Birks Bldg., Montreal, P. Q.

March 8, New York City. Snow Removal Conference at 247 W. 54th St., by the divisions of highway and municipal engineers of the National Highway Association; the Automobile Club of America; the Citizens' Street Traffic Committee of Greater New York, and the graduate course in highway engineering of Columbia University, beginning at 8:30 p. m., with a lecture by W. H. Connell, on "Modern Methods of Snow Removal."

March 23, 24, St. Augustine, Fla. The Florida State Good Roads Association.

May 8-10, Waco, Tex. The Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Texas.

May 10-17, Indianapolis, Ind. The National Conference of Charities and Corrections.

June 4-8, New York City. The American Water Works Association. J. M. Diven, secretary, 47 State St., Troy, N. Y.

June 15-16, Cleveland, O. Ohio Society of Mechanical Steam and Electrical Engineers. J. L. Skeldon, president, Toledo, O.

June 28-30, Battle Creek, Mich. Michigan League of Municipalities.

July 9-16, Detroit, Mich. The World's Salesmanship Congress. Walter C. Cole, general secretary, Detroit Board of Commerce Building.

July 11, 12, Goshen, Ind. Municipal League of Indiana.

September 6-9, Newark, N. J. League of American Municipalities.

August 7-9, Houston, Tex. City Marshals' and Police Chiefs' Union of Texas.

Technical Associations

The American Road Builders' Association holds its elections prior to its congresses and on February 4 met in New York and elected as president E. A. Stevens, the New Jersey state commissioner of public roads.

The Water Power Development Association is a new organization made up of the manufacturers of hydraulic power and electrical apparatus and accessories to establish a propaganda for the reasonable development of water power in the United States, particularly on the public domain, and to advocte reasonable regulations for the operation of water powers on government lands and reservations. Marcus A. Beeman is the secretary, with offices in Washington. Representatives I. P. Morris Co., Allis-Chalmers Mfg. Co., Wellman-Seaver-Morgan Co., R. Thomas & Sons Co., and the Westinghouse Electric and Mfg. Co., are on the organization committee.

The National Municipal League offers two prizes of $30 and $20 to high school pupils for the two best essays on keeping highways clean, concerning which information will be given by Clinton Rogers Woodruff, secretary North American Building, Philadelphia Pa. The essays must be forwarded to him not later than April 15. The prizes for last year's essays on fire prevention were awarded to Margaret Reich, of Milwaukee, and Robert F. Matthews, of Louisville, there being 62 competitors.

The state bureau of municipal information of the New York State Conference of Mayors and Other City Officials, W. P. Capes, Albany, N. Y., director, has published data collected regarding methods and cost of collecting and disposing of garbage in about 50 cities in New York and about the same number of cities in other states and a digest of the data and the letters accompanying the information blanks, which will give some interesting information and shows some improvement in the treatment of this important city problem. There is room for very much more improvement.

The League of Iowa Municipalities has called a meeting at the Savery hotel, Des Moines, Iowa, for March 14, 10 a. m., to consider the effect of the defeat of Winchester, Ky., in its contest over the septic tank patent and to take such action as those present may deem advisable. F. G. Pierce, secretary, Marshalltown, Iowa.

The municipal engineers of the city of New York on February 23 heard a paper on the new roads around Ashokan reservoir by Francis B. March, assistant designing engineer; J. D. Groves, assistant engineer, and Charles E. Price, inspector. Daniel L. Turner, is president for 1916 and George A. Taber is secretary.

Technical Schools

The illustrated lectures on highway engineering at Columbia University, New York, in March include one on drainage and foundation problems due to soil and other geological conditions by Charles J. Bennett, Connecticut state highway commissioner on the 6th; one on modern methods of snow removal by William H. Connell, chief of the bureau of highways and street cleaning of Philadelphia, on the 8th; one on loadings and floors for highway bridges, by Walter R. Marden, chief engineer of the United Construction Co., on the 13th, and one on methods of securing an efficient engineering organization in states and municipalities, by John A. Bensel, consulting engineer, New York, on the 20th.

An important conference on drainage and related subjects will be held at the University of Illinois under the auspices of the Department of Civil Engineering, March 8-11, 1916. Land reclamation, flood protection, levee construction, and the importance of such work to the agricultural interests of the

state are subjects which will be discussed by engineers and contractors who have specialized in such work. The program includes the names of such men of prominence as George Parsons, president of the National Drainage Congress; Edmund T. Perkins, and Isham Randolph, consulting engineers; S. H. McCrory, chief of drainage investigations, United States Department of Agriculture, and W. L. Park, Illinois Central Railroad. The practicability will be considered of having an annual short course in drainage engineering under the direction of Professor F. H. Newell, head of the department of civil engineering and formerly director of the United States Reclamation Service. All who are interested in the subjects mentioned are cordially invited to attend.

Personal Notes

Ossian E. Carr is the new city manager of Niagara Falls, N. Y., having moved up from a like position in Cadillac, Mich.

F. H. Williams has been promoted to the office of city manager of Brownsville, Tex., having had charge heretofore of the water and light plant.

Chester E. Albright is the new chief engineer of the bureau of surveys of the Department of Public Works of Philadelphia, Pa., under the general change of officials made by the new mayor.

Arthur W. Kreinheder is the new commissioner of public works of Buffalo, N. Y., taking the place of Francis G. Ward, deceased.

D. W. Chamberlain is surveyor for the county highway commission of El Paso, Tex.

Edward B. Codwise is again appointed city engineer of Kingston, N. Y.

W. M. Donley is engineer of Allegheny county, Pa., which is doing a large amount of road construction.

E. E. Porter is city engineer of Uniontown, Pa.

J. M. Snow has been appointed city engineer of New City, Pa.

E. G. Bush is the county road superintendent for Clay county, at Brazil, Ind.

Brooks Connell has been appointed road engineer of Pike county, Alabama.

C. W. Folger is the new county road superintendent for Bartholomew county, at Columbus, Ind.

A. L. LaRoche is a new deputy city engineer in Binghamton, N. Y.

B. K. Finch is city engineer of Wilkes-Barre, Pa., under the city commission, which recently took office.

Following are newly-elected mayors:

W. F. Elliott, at Harrisburg, Ore.

Dr. J. P. Truax, at Grant's Pass, Ore.

Eugene Courtney, at Lafayette, Ore.

Capt. R. A. Bensell, at Newport, Ore.

Dr. H. A. Beauchamp, at Stayton, Ore.

Mrs. Clara Larsson, at Troutdale, Ore.

Andrew Kershaw, at Willamina, Ore.

J. V. Josek, at Wilkes-Barre, Pa.

A. N. Johnson, recently with the Bureau of Municipal Research, New York City, and formerly in charge in succession of the state highway departments of Maryland and of Illinois, is now the consulting highway engineer of the Association of American Portland Cement Manufacturers.

The following are newly-appointed chiefs of fire departments and fire commissioners:

R. L. Patterson, president of fire commission at Elizabeth, N. J.

William Berger, at Tremont, O.

Taylor C. Burke, at Chester, Pa.

Allie Longtine, at Titusville, Pa.

Frank Hochreiter, at Wilkes-Barre, Pa.

William H. Covell, commissioner at Providence, R. I.

The following are newly-appointed chiefs of police and heads of safety departments:

John Martin, at Buffalo, N. Y.

L. Kummer, city marshal at Troutdale, Ore.

W. J. Cullen, at Hazleton, Pa.

Theodore Chelow, commissioner at New City, Pa.

H. S. Edwards, at Titusville, Pa.

Fred Goeringer, superintendent of public safety, and E. S. Zoeller, chief of police, at Wilkes-Barre, Pa.

Joseph A. Black, at Charleston, S. C.

J. E. Orr, at Lancaster, S. C.

The following are newly-appointed street commissioners and heads of street departments:

S. S. Glasgow, at Oxford, O.

W. D. Gerlach, at Hazleton, Pa.

W. J. Welter, at New City, Pa.

John Williams, at Uniontown, Pa.

Martin Murray, at Wilkes-Barre, Pa.

H. M. Wells, at Salt Lake City, Utah.

H. K. Barrows will continue practice as a consulting hydraulic engineer in water power, water supply and sewerage, at 6 Beacon street, Boston, Mass.

C. B. Breed will continue practice as a consulting engineer in railroad structural and municipal projects, at 6 Beacon street, Boston, Mass.

The firm of H. K. Barrows and C. B. Breed, consulting engineers, has been dissolved, and the two members of the firm, as noted above, will continue their separate business in the same offices as heretofore, at 6 Beacon street.

Edmund F. Saxton, recently assistant director of the Department of Wharves, Docks and Ferries of Philadelphia, and formerly chief engineer of railways and in charge of testing laboratories, has opened offices in the Pennsylvania building, Philadelphia, for practice as consulting engineer in municipal problems, valuations, railways, ocean and river piers and wharves, and will pay special attention to projects in Latin-American countries.

Dr. M. I. Pupin, distinguished electrical engineer and physicist, has been notified by the Academie des Sciences of the Instut de France that the Hebert prize has been awarded to him for his "method of mathematical analysis of electrical circuits, which is today recognized as classical," and for his "discoveries and inventions in electrical resonance, the tuning of electrical circuits and the loading of telephone lines."

Proposed Legislation to Increase Military Training in Colleges

Bills have been introduced in both Houses of Congress to increase the scope of the training and instruction in military science in colleges now having a detail of an army officer for this instruction so as to make the instruction more effective in training men for possible use as officers in a regular or volunteer army in case of need. The proposed law does not interfere with any other bills now before Congress or in contemplation, but proposes simply to enlarge and make more complete and efficient the facilities already offered in this line.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

March 7: Chief of editorial division in Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., at $2,500 a year.

March 7: Mechanical draftsman, Ordnance Department at Large, in Frankford Arsenal, Philadelphia, at $1,320 a year.

March 8: Aid qualified in engineering in Bureau of Standards, Pittsburg, Pa., at $840 a year.

March 15, 16: Ship draftsman in Bureau of Construction and Repair, Navy Department, Washington, D. C., at $4 to $5.04 a day for grade 1, and $3.28 to $4 for grade 2.

March 15, 16: Marine engine and boiler draftsman in machinery division of New York navy yard, at $5.04 a day.

April 12, 13: Laboratory assistant in Bureau of Standards, Department of Commerce, at $900 to $1,200 a year.

War Profits From Garbage

The city of New York may obtain payment for its garbage. The war and the resultant demand for nitroglycerin are given as the reasons for a legal contest which has begun for a contract to remove the garbage of New York City. Altho the city has paid $3,750,000 in seventeen years for removal of its garbage, a company now offers the city $900,000 for that privilege for five years.

Counsel for the new bidder explained why the garbage had suddenly become so valuable by saying that the product of garbage after being treated with steam is grease, the value of which at present is high. From this grease, he said, comes glycerin, from which is made nitroglycerin.

New Sewers for Evanston

An ordinance was recently passed by the Evanston city council granting permission to the sanitary district of Chicago to build an intercepting sewer and branches, thus supplementing the present sewerage system which is said to be inadequate.

The proposed sewer as outlined in the ordinance will consist of a large intercepting sewer in Lake street, which runs east and west, connecting with the drainage canal; a large branch sewer in Orrington avenue, which runs northeast and southwest, and smaller branches in Sherman avenue and in other streets. The estimated cost will be $700,000.

Sanitary District Appropriation

The Sanitary District Board, city of Chicago, announces the contemplated expenditure of $9,072,597 during 1916.

The revenue of the district is estimated at $8,562,800. This is composed of $2,019,103 in cash surplus in the bank at the beginning of the year, $1,062,800 due from the city and payable, according to contract, or or before July 1, next, the proceeds of a $2,000,000 bond issue, and the remainder in taxes and revenue from the hydro-electric plant, rent of dock property and sale of stone and black earth.

A summary of the appropriation, which is printed in the board proceedings, is as follows:

Illinois River Bureau	$ 39,750
Chicago River improvement	730,000
Calumet-Sag Canal	2,000,000
North Shore Canal	90,000
New bridges	483,050
New sewers	2,106,500
Pumping stations	210,300
Other engineering	360,000
Electrical department	774,699
Police department	41,000

Practically all of the work on the Calumet-Sag ditch is being done by contract. Upon the progress of the contractors depends the amount of expenditure from the $2,000,000 set aside for this purpose.

The bridge program includes $105,000 for the Jackson boulevard bridge, $90,000 for the Twelfth street bridge, $247,500 for several bridges across the Calumet-Sag Canal.

Big Chicago Sewer Finished

A big work undertaken by the sanitary district was recently brought to a successful conclusion by the completion of the big north shore intercepting sewer. This diverts from the lake the sewage from the villages north of Evanston and turns it into the north branch of the river. It is seven miles long and its completion removes what was the most serious menace to the health of the people of Chicago and near-by towns which draw their water supply from the lake.

Publications Received

The Massachusetts Bureau of Statistics, established in 1869 as the first of its kind, has issued a sketch of its history, organization and future, with a list of its publications and illustrations of the results of its work. This book was prepared for the Panama-Pacific Exposition exhibit by Charles F. Gettemy, director. The bureau's policy and methods of work were first thoroly established in the early '70's by Carroll D. Wright, and ever since it has been an important source of authentic data upon labor conditions in the state.

Bulletin 257 of the U. S. Department of Agriculture is a contribution from the Office of Public Roads, giving progress reports of experiments in dust prevention and road preservation in 1914. Bulletin No. 249 is on portland cement concrete pavements for country roads, and is by Charles H. Moorefield and James T. Voshell.

The Chicago City Manual, prepared by the Chicago Bureau of Statistics and Municipal Library, is another successful attempt to make a municipal publication popular. It does not give the mass of statistics formerly included in it, and it gives the names of the principal officers in the various departments. Historical and descriptive matter in popular form gives information about parks, duties of various offices, etc.

George G. Earl, general superintendent of the Sewerage and Water Board of New Orleans, has made a brief but comprehensive report of the hurricane of September 29, which was so destructive of property in Louisiana, and of the subsequent heavy rainfalls, which shows what was the efficiency of the pumping plants for drainage which have been put in operation by the board, and what should be done to complete and fortify the system.

The Chamber of Commerce of the United States has prepared a pamphlet giving the reasons in favor of a permanent tariff commission as a national business policy, as voted for by the organizations represented in the body, the vote being 715 for the permanent tariff commission and 9 against it.

The proceedings of the Conference on Valuation, held in November in Philadelphia under the auspices of the Utilities Bureau, are contained in the January number of the *Utilities Magazine*, the bi-monthly organ of the bureau, which is sold at $2, subscription for the year being $5.

Proceedings of the eighth annual convention of the Indiana Sanitary and Water Supply Association. Dr. W. F. King, secretary, Indianapolis, Ind.

"City Planning," with special reference to the planning of streets and lots, by Charles Mulford Robinson, is a revised reissue with much additional material of a book on the width and arrangement of streets, written by Mr. Robinson some years ago. It is eminently practical in its treatment of the subject and pays special attention to methods and results of changing layouts already in use. It is fully illustrated with very pertinent drawings and photographs; 344 pages, $2.50. G. P. Putnam's Sons, New York.

The third volume of Metcalf & Eddy's "American Sewerage Practice," which treats of the disposal of sewage, is issued, completing the most complete American publication devoted to sewerage. It has 851 pages, and its price is $6. It is published by the McGraw-Hill Book Co., New York City.

MACHINERY AND SUPPLIES

Gas-Electric Semi-Trailers

In the motor truck section, appearing in this issue, is illustrated a Couple-Gear dump bottom trailer as used by a prominent New York contracting firm. A similar semi-trailer has a capacity for handling from eight to twelve tons. The power equipment consists of a 4-cylinder 4-cycle 5¾x6 engine and 13-kw. generator, and all of the four wheels under the tractor are power wheels. The forward end of the body being connected by pivot to the frame of the tractor, approximately 65 per cent. of the pay-load is carried upon the rear axle, which is equipped with large steel tired wheels.

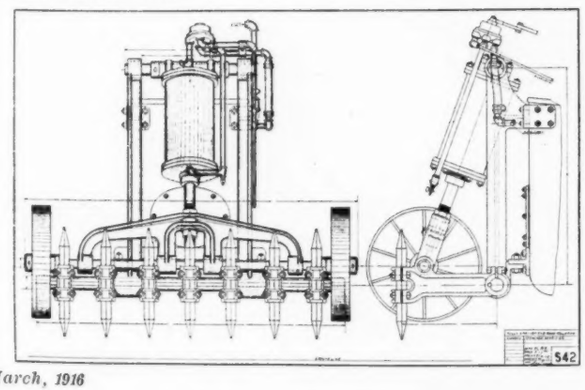
Still another type is of 6-ton carrying capacity, giving from 25 to 35 miles travel from a single battery charge, and discharges its load at the rear by dumping. It is equipped with hand-crank dump. Ninety per cent. of the pay-load is carried on the rear axle. The tires on the rear wheels give 2,000 to 3,500 miles per set, while the rubber traction tires on the forward wheels give us from 7,000 to 10,000 miles.

Pressure Cylinder Scarifier

We are illustrating, in this issue, a pressure cylinder scarifier specially designed for street and road work. The outfit consists of a Kelly-Springfield special steel-built steam or gasoline roller, fitted with seven or more sturdy separate plows or scarifiers, all of which are fastened to and pulled by a common rocking shaft directly attached to the main draw bars by means of a massive steel frame.

This frame contains the entire scarifier, including the two heavy steel rocking shafts, the oscillating compression cylinder, piston and rod, the cross-head fork and the individual scarifier beam or arms.

The road-roller engineer pulls forward the lever controlling the pressure valve and the tool-steel points are forced thru the road surface. The depth and width of cut are controlled by the operator and regulated to suit the exact conditions of the work. The usual width of cut is 6 feet, or the full width of the road roller.



The pressure is applied by means of a swinging cylinder and a reverse pressure is provided for instantly removing the scarifier teeth from the ground. Also, this cylinder pressure insures full elasticity so that the teeth dig to a uniform depth, even on the roughest surfaces. The cylinder further serves as a relief in case of striking solid rocks or other obstacles, and absorbs the shock and vibration on hard work.

The following features are claimed for this new device: One man operates both the roller and scarifier; scarifies the entire width of roller, approximately 6 feet wide, at the regular traveling speed of the roller; enters work instantly upon opening valve lever; raises automatically upon striking hidden obstacles; operator can raise scarifier instantly upon passing over cross walks, manhole covers, etc.; variable depth and width of cut to suit different working condition; scarifier is entirely behind the roller, making every part accessible and giving room for wide clearance when disengaged from work; has separate arm for digging tools, thereby avoiding the usual clogging of materials ahead of tooth bars; direct connected compression cylinder, giving force sufficient for tearing up hardest stone streets and roads and with long stroke to give elasticity required to maintain uniform cutting depth on extremely uneven surfaces.

The above described pressure cylinder scarifier is manufactured by the Kelly-Springfield Road Roller Co., Springfield, O.

New Car Unloader Chute

In a new type of car unloader chute the arms are independent of the pan or tray. The tray is supported by cast steel trunions which drop into slots in the elevators. This type of chute is very simple in its design and no latches or other devices are necessary to retain it in regular position. There are no rivet heads appearing in the pan and the extra bend given at the edge greatly reinforces the tray.

The accompanying illustration gives an excellent view of the working and mechanical operation of this car unloader chute, which has recently been designed and perfected by the Heltzel Steel Form & Iron Works, Warren, O. It combines a number of improvements over the ordinary unloader chute, and is a great saver of time in transferring bulk material, such as sand, gravel, slag and other material from an open freight car to wagons or motor trucks.

The pan or tray is designed to retain a maximum load without spilling, and plenty of clearance is allowed between the car and truck.

The top of the chute is reinforced by means of double angle bends, which also afford a ready handhold, and a clear open end faces the shovelers, the pan being slightly turned up to prevent the material from sifting back into the car.

No lock or device is necessary to hold the chute in position, as the center of gravity is so placed that a 20-pound lift or pull

HELTZEL *car unloader chute.*

will tilt the loaded chute, after which the chute rights itself by gravity.

No bars or rods pass thru the chute, causing interference with the material. Elevated arms, entirely separate from the body, permit the same to be placed independently on the car. To the chute are riveted cast steel trunnions which drop into slots in the elevator supports.

The greatest characteristic of the chute is the lightness thruout, without a sacrifice of strength.

It is shipped and handled complete in three separate parts and is unequaled for ease of moving and putting in place on the side of a car. This is an exclusive and important feature.

Already several hundred of these chutes have been placed on the market with a marked degree of success.

Shallow Excavation by Steam Shovel

We are illustrating Erie steam shovels as used in shallow excavation on state (N. C.) highway work, as well as for similar purpose by Lennane Bros and L. V. Metz.

The following table contains an L. V. Metz record of yardage moved daily on a Pennsylvania state highway contract, Erie to Wesleyville, Pa.

One and one-half cubic yard wagon used—loaded full.

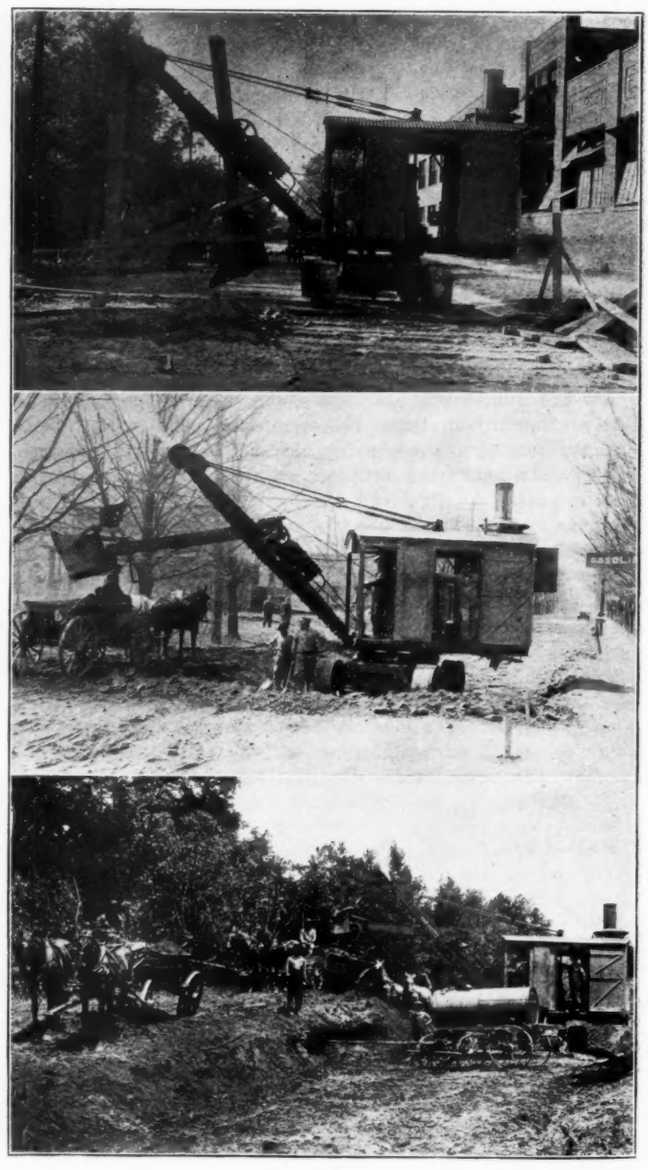
Day	Date-1915	cut	1½-cu. yd. loads per day
Monday	Apr. 12	10-in.	(Started noon)..... 85
Tuesday	Apr. 13	12-14-in.	 342
Wednesday	Apr. 14	12-14-in.	.....*246
Thursday	Apr. 15	16-in.	 447
Friday	Apr. 16	18-in.	 535
Saturday	Apr. 17	18-in.	 528
Monday	Apr. 19	24-in.	 605
Tuesday	Apr. 20	12-in.	 491
Wednesday	Apr. 21	8-in.	 326
Thursday	Apr. 22	12-18-in.	 458
Friday	Apr. 23	12-18-in.	 422
Saturday	Apr. 24	12-18-in.	.....†210
Monday	Apr. 20	12-in.	 422
Tuesday	Apr. 27	12-in.	 426
Wednesday	Apr. 28	12-in.	 449
Thursday	Apr. 29	12-in.	 412
Friday	Apr. 30	12-in.	 416
Saturday	May 1	14-in.	 460

*Two hours lost account water pipes in road.
†Stopped 2 p. m., held up securing water.

The Shore Transfer Co., Winston-Salem, N. C., submit the following record of performance on a type B Erie shovel on a North Carolina highway contract near Winston-Salem, on which the depth of cut ranged from 1 foot to 6 feet:

Date	Remarks	No. 1½-yd. wagon loads	Date	Remarks	No. 1½-yd. wagon loads
6-26-15		424	7- 8-15		555
6-27-15	Sunday		7- 9-15		501
6-28-15		313	7-10-15		502
6-29-15		452	7-11-15	Sunday	
6-30-15		431	7-12-15		486
7- 1-15		551	7-13-15		624
7- 2-15	Rain		7-14-15		514
7- 3-15		761	7-15-15		765
7- 4-15	Sunday		7-16-15	Moving Shovel	302
7- 5-15	Holiday		7-17-15	Rain	
7- 6-15	Rain		7-18-15	Sunday	
7- 7-15		492	7-19-15		407

ERIE SHOVEL *on shallow excavation encountered in road construction.*



7-20-15	367	8- 3-15 Rain	
7-21-15	500	8- 4-15	587
7-22-15	340	8- 5-15	438
7-23-15	818	8- 6-15	411
7-24-15	640	8- 7-15	302
7-25-15 Sunday		8- 8-15 Sunday	
7-26-15	716	8- 9-15	409
7-27-15	730	8-10-15	506
7-28-15	601	8-11-15	485
7-29-15	503		
7-30-15	392	Work completed	
7-31-15 Rain		Total loads 17,328	
8- 1-15 Sunday		Average loads	
8- 2-15	503	per working day...	509

Lakewood "V" Dump Wagon

We are illustrating a type "V" dump wagon which consists of a steel frame fitted on a wagon truck, this steel frame carrying the up-rights and standard "V" dump car body.

In many plants and sand, gravel and clay banks, where it is inconvenient to use cars and tracks, possibly because of steep grades, etc., this style of "V" dump wagon is increasingly popular. In dumping, it throws the load out of the way of the wagon wheels, thus in many cases making it a much more satisfactory dump wagon than a bottom dump wagon,

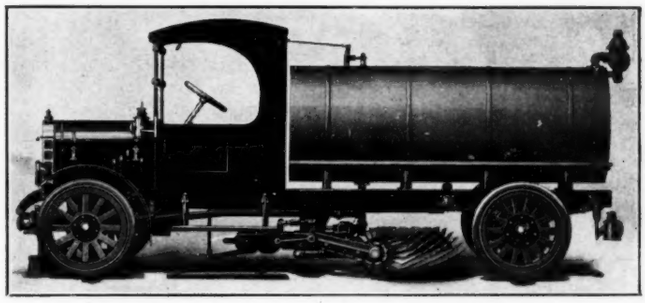
which throws the material under the wheels and makes it necessary for the horses to pull the wagon out over the dumped pile.

As will be noted in the illustration, the contractors have mounted the steel frame, which supports the "V" body, on their own wagon trucks, thus giving the car body the same features as the regulation or standard Lakewood car as regards dumping, locking device, etc. The body, which is furnished by the Lakewood Engineering Co., Cleveland, O., may be locked in a semi-dump position.

Motor "Squeegee" Street Washer

Arrangements have been perfected whereby the Kindling squeegee, mounted on a Sterling chassis, will be featured as the Sterling-Kindling motor squeegee street washer.

This machine consists of a special Sterling worm-driven chassis upon which is mounted a 1,000-gallon oval-shaped steel tank. Placed immediately in front of the front fenders of the chassis are two flusher nozzles controlled by the driver by a lever from his seat. The flusher nozzles by sprinkling the surface of the street prevent the agitation of dust, and also dampen the attached matter so that the squeegee roller can easily force it loose from the pavement and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted immediately behind the front nozzles, the purpose of which is to force aside the large refuse so that it will become suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the center of the chassis frame and immediately underneath is a squeegee or spiral-shaped roller of 19 inches diameter and 8 feet long. Each individual, specially treated rubber spiral is firmly but easily detachable, and mounted in a special kiln-dried wood holder of large wearing surface. And being adjustable as they wear, more fresh surface of the squeegee can be brought into engagement with the street. The squeegee attachment is flexibly mounted and counter-balanced in such a way that when adjusted to a certain pressure, it is impossible for the roller to work loose and the pressure against the surface of the street is uniform, the rubber strips being six inches deep, affording large wearing surface. A toggle joint linkage terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street; and when returning from washing a section of street to lift the roller out of contact with the pavement.



The tank is fitted with a water meter which indicates the amount of water flowing thru it. The water meter serves not only as a safeguad against the squeegee operator's idling and claiming to have squeegeed more street surface than he has, but gives data for calculating the water consumption per square yard for different kinds of pavements, under different conditions, etc. The tank contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.

The Allen Distributer

The Municipal Equipment and Construction Company, Chicago, are marketing a motor-driven outfit known as the Allen distributer, so designed as to enable the chassis to carry any type of body.

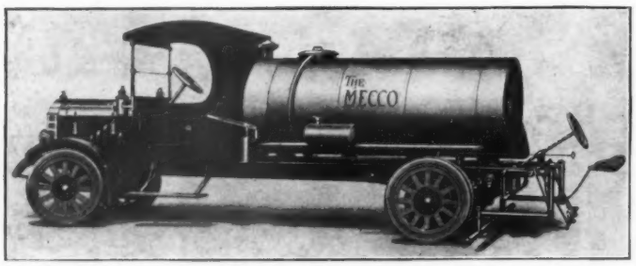
The Allen distributer applies the binder, whether a light dust-laying oil or heavy asphaltic oil, by a pressure spraying device which spreads the oil uniformly over the surface of the road in any quantity required from one-eighth of a gallon per square yard and upward.

All parts of the machine are under the control of the driver, the most important of which is the pressure regulation and gauge which shows the amount of oil being distributed. The temperature is easily controlled and an agitator keeps the warm oil constantly in motion, thus giving an even temperature thruout the tank.

This machine is self-loading, no extra engine being required where heat is already applied to tank or storage cars.

The manufacturers are also furnishing attachments for the connecting of the rear portion of any road sweeper for use in cleaning the roads before applying the oil or binder.

The nozzles are of a new non-clogging type.



The heaters cover a large portion of the tank, the burners being supplied with kerosene from the pressure tank on the side of the apparatus. It is said there is no loss of heat, since the entire heater is lined with asbestos and by a peculiar arrangement of baffle plates the heat is said to be evenly distributed around the tank. The double rotary force-pump, which is positive in its action, is available for either loading or distributing. The distributer pipes are sectional, giving a totai width of eight feet.

As the pressure regulator is controlled from the driver's seat and the gage is constantly in view, the penetration is very easily controlled according to pressure. The by-pass agitator is also readily controlled and takes the material from the bottom of the tank, driving it back thru the top, thus insuring an absolute and uniform temperature.

This concern is also building an internal heater machine which is known as the "Mecco," and which is of the same construction as the "Allen" but with internal heating arrangements. This machine can also be furnished with flusher heads in which case the stream is controlled by the rear man. But one man is required to operate the Allen.

These machines are built in 600, 750 and 1,000-gallon capacities.

New Model Pumper.

The city of Independence, Kans., has held its test and has in service its new "South Bend Double Duty" 140-h.p. combination pumping engine and hose carrier.

Three lines of hose, 200 ft. each, were siamesed into one 1¾-in. nozzle, throwing a stream 145 ft. in height. These lines were afterward broken into three separate lines, two 1-in.

nozzles and one 1⅛-in. nozzle, throwing three streams to the top of the Booth Hotel, which is six stories in height, these streams being thrown at a pump pressure of 130 pounds.

This piece of apparatus was then taken to the city reservoir and subjected to a six hours' steady pumping test, maintaining pump pressures of 125 to 275 pounds.

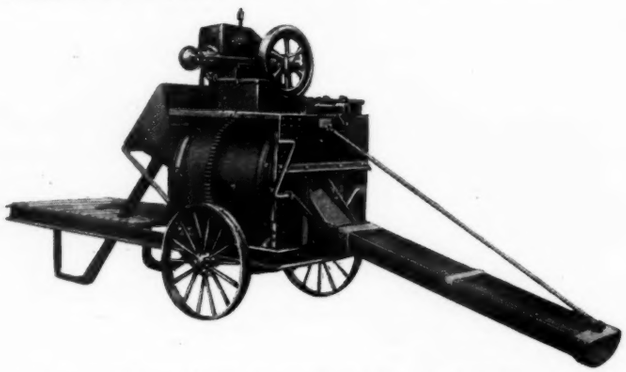
The tests as above described were entirely satisfactory to Mayor Kerr, Fire Chief Pitts, city officials and citizens—all concerned were highly pleased, as the pump more than met the required specifications.

This outfit, which has a hose carrying capacity of 1,200 ft., is equipped with a two-speed transmission rotary geared pump.

After the above tests the pumper, under full load, with five men, 13,000 pounds in all, attained a speed of 55 miles an hour. This piece of apparatus is equipped with Sewell cushion wheels, and was made by the South Bend Motor Car Works, South Bend, Ind. This outfit, which is a distinct departure in certain respects, marks a new era in pumper construction.

Archer Mixer With Paving Chute

We are illustrating an Archer mixer equipped with a road and street paving swing chute, showing the ready adaptability of a mixer of moderate size for paving service by the single attachment of a chute.



This machine, which is made by the Archer Iron Works, Chicago, is equipped with a gear drive thru a single countershaft equipped with a clutch for starting and stopping the mixing drum. All high-speed gears are machine cut and housed.

The charging platform is 5 feet long and 38 inches wide and stands only 21 inches above the ground. Wheelbarrows are wheeled up onto the platform by laying a plank runway on the brace at the end of the platform.

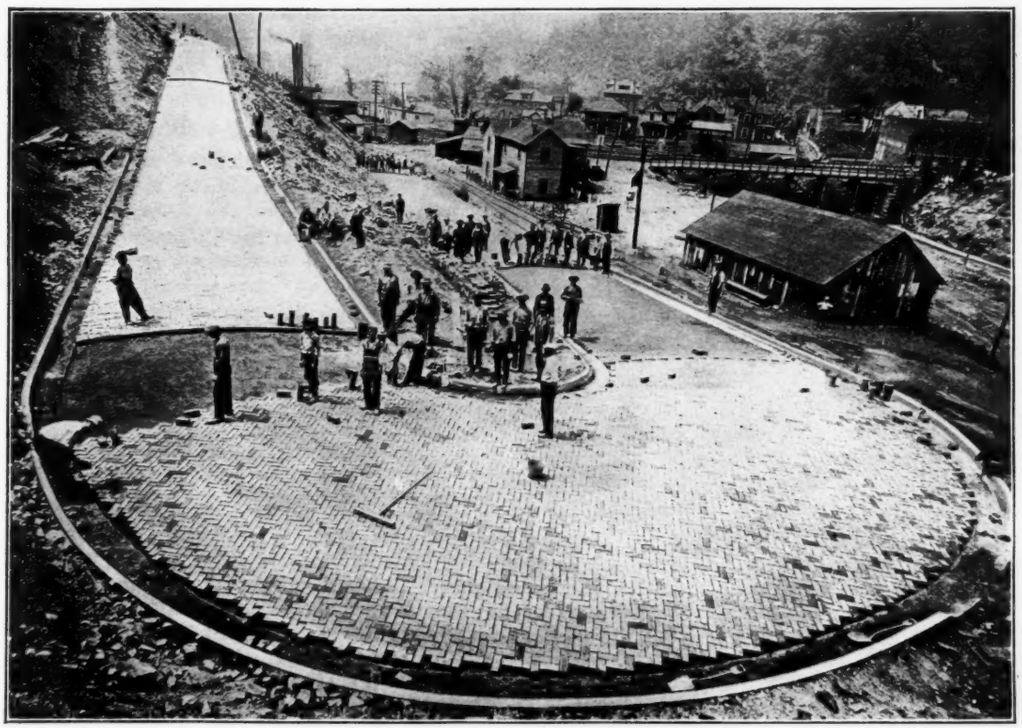
New Type Hose Wagon

The South Bend Motor Car Works have just delivered to the city of Cleveland, O., a straight hose wagon equipped with a 6-cylinder motor developing 90 h.p., which has ample power to carry this car under full load at 45 miles per hour.

It is equipped with dual pneumatic tires in the rear and single pneumatic tires in front. It has a carrying capacity of 1,800 feet of 2½-inch standard rubber-lined fire hose. It has a section with division in this body in case of a large fire for the high pressure hose, which can also be removed for extra hose. This car has been placed in engine house No. 14, which makes an average of four to five calls daily. One of the features of this car is that all nickel trimmings, with the exception of the radiator and bell siren, have been eliminated.

Big Saving Over Wood Forms

When the present extensive road building operations are completed Marion Co., W. Va., will have a system of highways equal to any in the country. The streets are of brick on a concrete base with concrete curb and gutter. The contract for paving over twelve miles of streets just out of Mannington, W. Va., was awarded to the Pietro Paving and Construction Company, of Morgantown, W. Va.



CURVED AND STRAIGHT CURB AND GUTTER CONSTRUCTION BY THE PIETRO PAVING AND CONSTRUCTION COMPANY OF MORGANTOWN, W. VA.

The contractors used wood forms at the beginning of the contract, but soon abandoned them in favor of steel forms. With steel forms, they set over 1,000 feet of curb and gutters a day at a cost of less than fifty per cent. of what would be possible with wood forms. At one time they laid over 400 feet of steel forms and about 160 feet of wood forms. Before placing the concrete, it rained, and the wood forms became so warped they had to be taken up.

The 6-inch Blaw universal rails, bolted together, formed the back of the curb. A single 6-inch rail formed the front of the gutter. The front face of the gutter was formed by a wood face-rail which was removed as soon as the concrete was placed to permit of refinishing promptly. The expansion joints in the concrete were taken care of by dividing plates, which conformed to the design of curb and gutter required. These dividing plates were removed before the side rails and served as templets by which to strike off and finish the curb and gutter. The side rails being slotted every 12 inches, expansion joints can be made wherever desired. In using the Blaw universal rail for this work, the contractors were greatly pleased in that the same rail can be used on sidewalk, curb, curb and gutter, combined base and curb, and concrete roads of all types. No special rails are required.

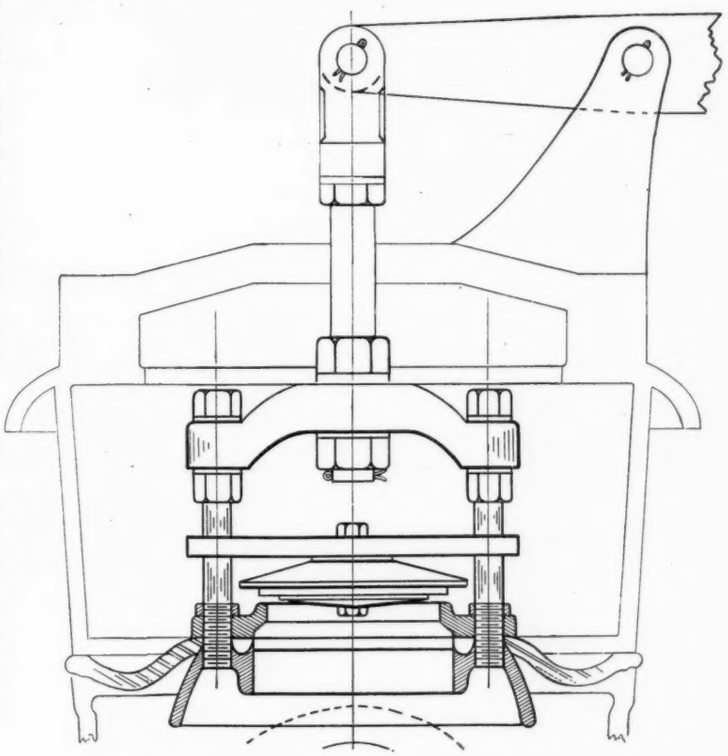
Combinations of straight rails with Blaw flexible rails were used in making most of the curves, tho in many sharp turns it was necessary to use the flexible rails altogether.

Diaphragm Pumps Now Rank With Other Pumps In Efficiency

For many years contractors and others have been using and have been compelled to use, the ordinary diaphragm pump which, operated by hand labor, and with its loose connections and quickly wearing parts, was expensive and very inefficient. With the adaption of the diaphragm pump to use with a gasoline engine it became necessary to strengthen and otherwise improve the pump in order that it might give service in step with the engine. Wear and tear was excessive, the pump splashed badly and the combination caused more or less trouble just at some critical time.

The manufacturers of the Atlantic pumping engine gave early heed to the demand for an improvement and determined to produce a pump that should compare favorably with the Atlantic engine in durability, efficiency and economy. The result was an entire new top head shown in cut, which eliminates every objection to an engine-driven diaphragm pump, besides which a decided increase in the capacity of the pump was secured. The advantages which every user of a diaphragm pump will appreciate may be listed as follows:

Capacity of pump increased more than one-half.



Annoyance of splashing water eliminated.

Positive piston stroke to diaphragm, prolonged life of diaphragm materially and giving full and regular length of stroke.

Rigid fulcrum on pump, avoiding breakage of bolt connection.

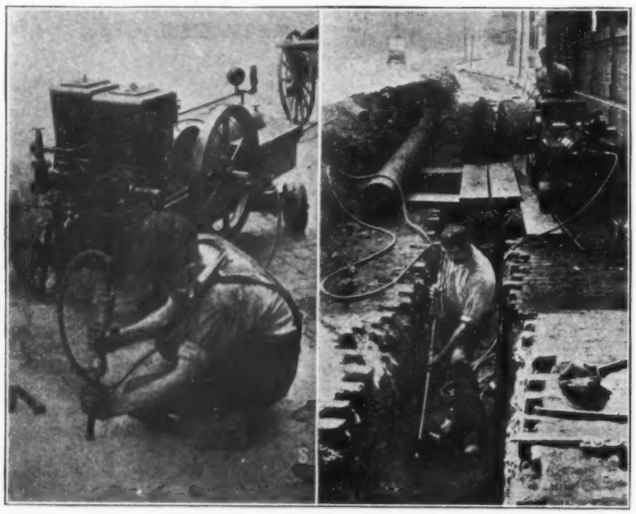
Improved waterway, increasing flow of water to pump, reducing friction and insuring a perfect valve seat.

The result has been to increase the prestige and demand for the Atlantic pumping engines and to persuade contractors to install one of these engines with either a single or a double diaphragm pump on work, where they have previously required pumps either more expensive in installation or in operation. A full descriptive catalog may be obtained by addressing Harold L. Bond Co., 383 M Atlantic Ave., Boston, Mass.

Schramm Compressor Outfit

We are illustrating a Schramm Portable Compressor outfit as used in roughing pavements and tamping back-fill.

For the air supply on larger jobs, it is often very convenient to use a series of smaller units. Contractors, ditchers, excavators and others who have much work to do as well as structural iron workers, can not always arrange their work so



ROUGHING PAVEMENT AND TAMPING
Back-fill with Schramm Compressor Outfit.

that one compressor unit will do all the work. On most jobs, the demand is comparatively light at the beginning. For this work one of the standard No. 2 units can be used. This gives 24 feet of air and weighs 1,200 pounds. This makes it an easy machine to get on and off of the job and at the same time it will handle many ordinary tools.

Expansion Joint Model 1916

The Pioneer Asphalt Company, Lawrenceville, Ill., has perfected its expansion joint compound. The new product is especially adapted for pavement purposes, possessing all of the desirable features of the 1915 model together with new improvements, which make the joint easy to handle, prevent it from breaking in the coldest weather and permit shipping in more economical and easily-handled packages.

This joint is primarily intended for use longitudinally between gutter and curb in brick, block and wood-block streets and roads, longitudinally and transversely in concrete and granite block streets, transversely in sidewalk construction, along car tracks, around manholes and other surface openings and in concrete bridge construction.

Blawform Bulletin 69

The Blaw Steel Construction Company, of Pittsburgh, Pa., are mailing Bulletin 69 which contains twenty-eight pages of illustrations and descriptions of sidewalk, curb, curb and gutter and road forms; each form described is illustrated.

This bulletin also contains many large halftone illustrations of forms as being placed by prominent contractor concerns thruout the country. Particular attention is called to the illustrations and descriptions of forms for combined base and curb construction, concrete curb construction, combined curb and gutter construction, sidewalk construction, etc.

American Coal Products Company Changes Name to The Barrett Company

It is announced that the American Coal Products Company, well known in connection with the sale of sulphate of ammonia, and parent organization of the even more widely known Barrett Manufacturing Company, has decided to unite the good-will and high reputation of both concerns under the name of "The Barrett Company." The fact that all the roofing, waterproofing and building materials, as well as coal tar, oils, chemicals and similar products are made and widely advertised in the name of the Barrett Manufacturing Company, has added immensely to the good-will attached to the name, which increase has not been connected in the mind of the general public with the securities of the American Coal Products Company, altho this concern owns the stock of the Barrett Manufacturing Company.

The new company will have the same amount of stock as the American Coal Products Company, and the change of name will be accomplished by exchanging all outstanding certificates share for share.

The commercial dealings of the American Coal Products Company included the disposal of ammonia, more especially sulphate of ammonia, which enters largely into the composition of commercial fertilizers and is highly approved as a standard carrier of nitrogen. After February 1 these transactions will be carried on by the same personnel in the name of "The Barrett Company, Ammonia Sales Agency Department." The Agricultural Department, which has carried on propaganda for the use of sulphate of ammonia as a fertilizer, will continue as a department of The Barrett Company.

Branch Managers' Convention Great Success

The week of January 25 and 28 was a notable one for the Trussed Concrete Steel Company, as it marked the first annual convention of the branch managers held at their main plant at Youngstown, Ohio. Men gathered from every section of the country to co-operate in forming improved methods which would render greatest service to their clients. Not only every section of the country was represented, but representatives came from far distant countries, including Japan, Hawaii, South America and Porto Rico. Fully one hundred men were in attendance.

The general program of the convention included business sessions every morning and afternoon. Mr. Julius Kahn, president, gave the opening address, followed by an interesting talk and discussion on "Shop Practice," by T. H. Kane, manager of works. The noon recess was devoted to a thoro inspection of the manufacturing operations with a competent corps of guides to explain all the details.

The subject of "Steel Sash," was ably handled by P. M. Louwerse, manager of the sash department. Many interesting

points dealing with the manufacturers of the various types of sash were brought out, as well as information on stock sash, semi-stock sash and to-order sash. The branch managers entered into the discussion vigorously and told of their experiences in various parts of the country.

On the subject of "Reinforced Concrete" many interesting points in regard to design, systems of construction and local requirements were brought out. R. D. Snodgrass, chief engineer, talked on "Engineering Practice;" B. J. Sigmund, Philadelphia manager, on "The Value of Engineering Service," and Herman Fougner, New York manager, on "Experiences with Reinforced Concrete."

The subject of Hy-Rib and metal lath brought out interesting papers and discussion. Among these were: "Metal Lath," by J. Earle Heber, former Los Angeles manager; "My Method with Distributors," by Louis Baum, Kansas City manager; "Concrete Pavement," with armor plates for protecting the joints, and "Kahn Reinforcement," occupied one of the mornings' session under the leadership of John Bowditch, manager of the highway department. O. W. Chaffee, manager of the credit department, spoke on "Credits and Collections."

The convention closed on Friday afternoon with a talk on general subjects by Gustave Kahn, general manager of sales. Addresses, banquet, supper, theater and motion pictures formed the evening entertainments.

Koehring Salesmen's Convention

Visitors to the recent cement show held in Chicago were aware of the fact that "The Koehring Boys" were at home to all comers.

The Koehring booth was a lively spot in view of the fact that Koehring representatives of all sections of the country were on hand. Each representative wore a special Koehring hat as well as a mammoth badge, giving his name and territory. No matter from what section a contractor or city engineer might come, he was sure to find a Koehring boy whom he knew.

The convention was continued in Milwaukee after the closing of the cement show, with headquarters at the Wisconsin hotel. Demonstrations, business sessions, "speech fests" and banquets made the convention a gala as well as an instructive occasion.

Brownhoist Schnable Bucket

We are showing two views of the Brownhoist Shnable patent drag line bucket as used on the Calumet-Sag Channel of the Chicago drainage canal. These views show the bucket as used by the contracting firms, Shnable & Quinn, Chicago, as well as Byrne Bros. Dredging and Engineering Co., Chicago.

BROWNHOIST SCHNABLE BUCKET *as used on Chicago Drainage Canal construction.*

One of the views shows the bucket beginning to dig. The operator with proper manipulation of the line can pick up a rock larger than the bucket itself, by clamping the rock, as in tongs, between the pulling bail and the digging edge, and this rock then is dumped front wise. Another remarkable service of the bucket is in digging or breaking into rock which has just been blasted, and it serves as a lever in separating the mass.

This bucket, which is of the back-dumping type, consists of a shell, a pulling bail, and a combination hoisting bail and back-gate. In its digging position the pulling bail is connected to the shell at points which are located above the center of gravity of the shell. The pulling bail is also connected by means of links to the hoisting bail and back-gate in such a way that tension on the drag-line forces the gate to close and remain so. When the bucket is suspended on the hoisting bail and the tension on the drag-line is released, the back of the shell tips down away from the back-gate allowing the load to slide and drop out. The pulling bail is connected to the shell by means of bronze sliding blocks carried in slots in the shell. These slots give to the link connections between the pulling bail and the back-gate the required motion to permit the bucket to dump when the tension on the drag-line is released. Special attention is given to flexibility of the bucket and to the prevention of binding in any of the parts by providing loose-fitting connections.

Trade Notes

J. A. & W. Bird & Co., distributers of Ripolin enamel paint, have moved their New York offices to the Equitable building, 120 Broadway. Altho Ripolin is manufactured in Holland,

their stock is large enough to take care of any reasonable demand without increasing the price.

After June 15 the subscription price of *Engineering Record* will be $5 a year.

The headquarters of the Association of American Portland Cement Manufacturers have been removed from Philadelphia to 111 West Washington street, Chicago, Ill.

Trade Publications

Bulletin No. 10 of the Waycleanse Company, Sandusky, O., shows in detail the construction and mode of operation of their automobile pneumatic street cleaning machine, with gas-electric operating power.

A reprint of a letter by Daniel T. Pierce, executive assistant, the Barber Asphalt Paving Company, Philadelphia, Pa., gives a large number of extracts from court decisions showing the legality of alternate specifications for public work in such states as Indiana, New Jersey, Pennsylvania, Kentucky, Ohio, Michigan, Maryland, New York, and the legal principles involved are applicable in any other state in which specific statutes do not prescribe the exact course of procedure. It will be sent to any one asking for it.

The Christmas card of the C. H. & E. Mfg. Co., Milwaukee, Wis., carries with it holiday greetings and blotters which will extend its message beyond the holiday season.

The Rochester Excavating Machinery Co., Rochester, N. Y., issues an illustrated catalog of the Fogarty excavating bucket, showing it excavating sewer trenches for large and small sewers thru various materials and bracing of trenches, taking gravel out of rivers, excavating for sewage treatment tanks, taking clay from a pit, loading clay on cars, etc.

The Berger Mfg. Co., Canton, O., send full data with photographs of fire tests on metal lumber pressed steel construction: (1) an unofficial test; (2) a test before some sixteen building commissioners and engineers, both made by the Canton laboratories; and (3) an official test by James S. MacGregor and the New York City building bureaus at the Columbia fire testing station, Greenpoint, Brooklyn, N. Y.

"The Asphalt Primer and Colloidal Catechism," issued by The Barber Asphalt Paving Company (Philadelphia) contains in question-and-answer form an easily understood explanation of the principles of colloidal chemistry as applied to the paving industry. An asphalt mixture, it is explained, must be regulated on the basis of the relation of surfaces and films. The presence of colloidal matter, such as has been discovered in Trinidad asphalt, enormously increases the surface area of the aggregate and results in a more closely held and thicker film of bitumen about the particles of the aggregate. In this way is explained the "body" of Trinidad asphalt and the toughness and stability of mixtures in which it is the cementing agent. The Primer is a replica of one of Benjamin Franklin's publications and is illustrated with wood-cuts of ancient and modern highway building.

Water-proofing and damp-proofing, paints for hot and cold water and steam pipes, etc., are quite fully discussed in a publication by the Goheen Manufacturing Co., Canton, Ohio, entitled *The Scientist.*

The Eureka Water Heater Co., Chicago, Ill., are distributing matter advertising the Harding flameless combustion system.

Standard specifications for making water-proof and dust-proof concrete floors by the master builders' method are published by the Master Builders Co., Cleveland, Ohio.

Mexpet Record is an occasional publication of the Mexican Petroleum Co., Ltd., which gives beautifully illustrated information as to the properties of the company, its rapidly growing fleet, and the facilities for supplying its products which it is developing in various parts of the country.

The Studebaker oil heater and pressure distributer for oiling roads is described in circular No. 1023 of Studebaker, South Bend, Ind.

The National Concrete Co., Indianapolis, Ind., are distributing a pamphlet on the Listen truss for concrete bridges, showing its application to reinforced concrete girders and slabs.

The Reinforced Concrete Pipe Co., Chicago, Ill., have a handsome new booklet about reinforced concrete, which contains much valuable information about its use aside from the special information about their particular pipe.

The Detroit Board of Commerce publishes a leaflet entitled "Build the Maintenance Into the Road," a policy that satisfies the man who foots the bills, which uses the concrete roads of Wayne county, Michigan, as a concrete example of the truth of the principle.

The Chicago Pneumatic Tool Co. in booklet 224 show the various designs of their pneumatic compressors and fuel oil and gas engines.

The Kinney Manufacturing Co., Boston, Mass., are promoting the Kinney combination auto heater and distributer for bituminous materials, hot or cold, as well as that combination hand spraying tar and asphalt heater.

The Locomobile Company of America send a copy of their instruction book for Locomobile models, which is very complete and is thoroly illustrated and indexed, so that everything in it is available on the moment.

Warren Brothers Company have issued a new catalog of "Warren's Portable Asphalt Plant," which gives full information about this popular design of plant for laying asphalt and other bituminous pavements.

Busch-Silzer Bros. of St. Louis issue separately several handsomely illustrated descriptions and reports of success with Dresel oil engine installations in municipal lighting plants in Estherville, Iowa; Hutchinson, Minn.; Menasha, Wis., and elsewhere.

Warren's portable asphalt plant is the subject of a well-illustrated booklet regarding this interesting piece of paving apparatus, which has been issued by Warren Brothers Company, 142 Berkeley street, Boston, Mass.

The specifications for highway bridges adopted by the American Society for Testing Materials are issued for general distribution to those interested in them by Robert W. Hunt & Co., engineers, Chicago, Ill.

A new edition of Medusa water-proofed white portland cement catalog has been issued by the Sandusky Portland Cement Company, Engineers' building, Cleveland, O., and will be sent on request. It is well worth seeing.

A mono-rail grab bucket crane is shown in a circular of Alfred Box & Co., Philadelphia, Pa.

Harrison Safety Boiler Works, Philadelphia, Pa., have issued a valuable, interesting and handsome book on "Finding and Stopping Waste in Modern Boiler Rooms by the Use of Cochrane Meters."

The Studebaker Corporation, South Bend, Ind., in their serial No. 704, give the advantages of the Studebaker patent improved road oiler for preventing dust and preserving the roads.

The National Concrete Sign and Post Company have for distribution excellent photographic reproductions of sign and guide posts and lamp standards, of which they furnish a number of handsome designs. Their plant is at Grove City and office at Oil City, Pa.

The Pioneer Asphalt Company, Lawrenceville, Ill., has a new illustrated circular on the use of asphalt filler for brick pavements.

The Hollow Building Tile Manufacturers' Association of America, Cleveland, O., publishes a specification for hollow tile wall construction which it suggests for incorporation in municipal building codes.